



1988 TRUCK SHOP MANUAL

Supplement

Official

Ford

**1989
F-Super Duty
Commercial
Stripped
Chassis**

Navigation Tools: Click on the "Table of Contents" below, or use the Bookmarks to the left.

Index

Group

S U P P L E M E N T	Body Shell, Exterior Trim, Frame and Underbody (70000)	47
	Brakes (2000)	12
	Charging System (10000)	31
	Clutch and Manual Transmission (7000)	16
	Cooling System (8000)	27
	Diesel Engines	22
	Driving Axles and Driveshafts (4000)	15
	Exhaust Systems (5000)	26
	Fuel System — Diesel Engines (9000 D)	25
	Identification Codes	10
	Instrument Clusters and Controls (10000 & 19000)	33
	Main Wiring Harness, Circuit Protection and Connectors (14000)	34
	Starting System (11000)	28
	Steering (3000)	13
	Suspension (3000 & 5000)	14
	Wheels and Tires (1000 & 2000)	11



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1988-89 Ford F-Duty Commercial Stripped Chassis Supplement

IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

NOTES, CAUTIONS, AND WARNINGS

As you read through the procedures, you will come across NOTES, CAUTIONS, and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in PARK unless instructed otherwise for a specific operation. If you have a manual transmission, it should be in REVERSE (engine OFF) or NEUTRAL (engine ON) unless instructed otherwise for a specific operation. Place wood blocks (4" x 4" or larger) to the front and rear surfaces of the tires to provide further restraint from inadvertent vehicle movement.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts, when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on the vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle. Tie long hair securely behind the head.
- Keep hands and other objects clear of the radiator fan blades. Electric cooling fans can start to operate at any time by an increase in underhood temperatures, even though the ignition is in the OFF position. Therefore, care should be taken to ensure that the electric cooling fan is completely disconnected when working under the hood.

1988-89 F-Super Duty Commercial Stripped Chassis

Official Licensed Product

TRUCK SHOP MANUAL SUPPLEMENT



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foreword...

This 1989 Ford Truck Shop Manual Supplement has been prepared to provide information covering normal chassis, electrical and engine service repairs and maintenance for the 1989 F-Super Duty Commercial Stripped Chassis vehicles manufactured in Mexico.

Procedures, illustration and specifications unique to the F-Super Duty Commercial Stripped Chassis vehicle are included in this supplement. Procedures that are common to the F-Super Duty vehicle are included in the following Manuals:

- **1988 Light Truck Body, Chassis and Electrical Manual (Volume A).**
- **1988 Light Truck Engine Manual (Volume B).**
- **1988 Engine/Emissions Diagnosis Manual (Volume H).**
- **1988 Car/Truck Pre-Delivery, Maintenance and Lubrication Manual (Volume F).**

To aid in locating specific items in this manual, use the Section Index on the following pages.

The first page of each section contains an index to locate service operations covered in that section. Following the index in each section is a description that references the appropriate aforementioned 1988 Shop Manuals for procedures that are common to the F-Super Duty vehicles.

The descriptions, testing procedures, and specifications in this manual were in effect at the time the manual was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications, design or testing procedures without notice and without incurring obligation. Any reference to brand names in this manual is intended merely as an example of the types of tools, lubricants, materials, etc. recommended for use. Equivalents if available may be used. The right is reserved to make changes at any time without notice.



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SECTION 10-00 Identification Codes

SUBJECT	PAGE	SUBJECT	PAGE
GENERAL INFORMATION		GENERAL INFORMATION (Cont'd.)	
Equipment Codes	10-00-6	Vehicle Identification	
Incomplete Vehicle Rating		Number (VIN) Codes	10-00-4
Decal	10-00-2		
Vehicle Identification			
Number (VIN)	10-00-1		

GENERAL INFORMATION

Vehicle Identification Number (VIN)

A seventeen digit combination of numbers and letters forms the Vehicle Identification Number (VIN).

By looking at the seventeen digit VIN number a variety of information about the vehicle can be determined. The first three digits identify the manufacturer and the vehicle make and type. The fourth digit determines the Gross Vehicle Weight Rating (GVWR-Class) and Brake System for Ford completed Trucks and MPV's. For Buses and incomplete vehicles, the fourth digit determines the brake system (only). Digits five, six and seven identify the model or line, series, chassis, and cab or body type. The eighth digit points out the particular engine found in the vehicle. Digit nine is the VIN check digit. The tenth digit identifies the model year of a Ford completed vehicle, or the model year of the incomplete vehicle, if sold by Ford as an incomplete vehicle. The eleventh digit determines the assembly plant. Digits twelve through seventeen make up the sequence serial and warranty number. Digit twelve uses the letter "A" until the production or sequence of 99,999 units (digits thirteen through seventeen) is reached. Letter "A" then becomes "B" for the next production sequence of vehicles.

Refer to the code definition portion of this Section for specific definitions of the numbers and letters of the Vehicle Identification Number (VIN).

INCOMPLETE VEHICLE LABEL

THIS INCOMPLETE VEHICLE MANUFACTURED BY
FORD MOTOR COMPANY S.A., DE C.V.
APARTADO POSTAL 39 BIS
MEXICO 1, D.F.
VEH. IDENT. NO. 3 D F L F 5 9 I 5 K J A 00001
GVWR: 16,000 Lb/7257 Kg

06/88

FRONT GAWR	REAR GAWR	REAR REAR GAWR
6000 Lb 2722 Kg	11,000 Lb 4990 Kg	

	FRONT	REAR
TIRES	LT 235/85 R16E	LT 235/85 R16E
RIMS	16.0 x 6K	16.0 x 6K
PSI COLD	80	80

MAY BE
COMPLETED AS: X _____ X

CY4157-1A

GENERAL INFORMATION (Continued)

Incomplete Vehicle Rating Decal

On vehicles that are delivered as incomplete, an Incomplete Vehicle Rating Decal is affixed to the vehicle in place of a Safety Compliance Label.

**INCOMPLETE VEHICLE MANUFACTURED BY
FORD MOTOR CO, S.A., DE C.V.
APARTADO POSTAL 39 BIS
MEXICO 1, D.F.**

GVWR: 16,000 LB/7257 KG

06/88

VEHICLE IDENTIFICATION NUMBER 3DFLF59I5 KJA00001

ESTD-18173-AA

EXTERIOR PAINT COLORS						DSO
WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	SPRING
158	F591		C	73		232

CY4158-1A

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SAMPLE VIN NUMBER

3DF L F59 I 5 K J A 00001

Position 13-17 — Sequence Number — begins at 00001.

Position 12 — Constant "A" until sequence number 99,999 is reached, then changes to "B" and so on.

Position 11 — Assembly Plant

Position 10 — Model Year (Ford Completed Vehicles)

Position 9 — Check Digit

Position 8 — Engine Type

Position 5, 6 and 7 — Model or Line, Series, Chassis, Cab or Body Type

Position 4 — Brake System

Position 1, 2 and 3 — Manufacturer, Make and Type (World Manufacturer Identifier)

CY4159-2A

GENERAL INFORMATION (Continued)

VEHICLE IDENTIFICATION NUMBER
(VIN) CODESWORLD MANUFACTURER IDENTIFIER
(VIN POSITIONS 1, 2 AND 3)

3 D F L F 5 9 I 5 K J A 0 0 0 0 1

VIN Code	Manufacturer	Make	Type
3DF	Ford Motor Company of Mexico	Ford	Incomplete Vehicle (IV)

CY4160-2A

BRAKE SYSTEM
(VIN POSITION 4)

3 D F L F 5 9 I 5 K J A 0 0 0 0 1

Brake System	GVWR Class	GVWR Range	VIN Code
Hydraulic	Class 4	14,001 — 16,000 Lb	L
Hydraulic	Class 5	16,001 — 19,500 Lb	M

CY4161-2A

MODEL OR LINE, SERIES, CHASSIS, CAB OR BODY TYPE
(VIN POSITION 5, 6 AND 7)

3 D F L F 5 9 I 5 K J A 0 0 0 0 1

VIN Code	Line	Series	Chassis Type	Cab or Body Type	Vehicle Type*
F59	F-Series	F-Super Duty	4x2	Commercial Basic Stripped Chassis	IV

*IV means incomplete vehicle.

CY4162-2A

ENGINE TYPE, DISPLACEMENT, CYLINDERS,
FUEL TYPE, AND MANUFACTURER
(VIN POSITION 8)

3 D F L F 5 9 I 5 K J A 0 0 0 0 1

VIN Code	Displacement		Cylinders	Fuel	Manufacturer
	Liters	CID			
I	7.3	445	8	Diesel	Navistar

CY4163-2A

GENERAL INFORMATION (Continued)

CHECK DIGIT FOR ALL VEHICLES
(VIN POSITION 9)3 D F L F 5 9 I **5** K J A 0 0 0 0 1

CY4164-1A

VEHICLE MODEL YEAR
FOR FORD COMPLETED VEHICLES
(VIN POSITION 10)3 D F L F 5 9 I 5 **K** J A 0 0 0 0 1

VIN Code	Year
K	1989
L	1990
M	1991
N	1992

CY4165-1A

ASSEMBLY PLANT CODES
(VIN POSITION 11)3 D F L F 5 9 I 5 K **J** A 0 0 0 0 1

VIN Code	Vehicle Assembly Plant Name and Location
J	Monterrey, N.L.: Mexico

CY4166-1A

PRODUCTION SEQUENCE NUMBER
(VIN POSITIONS 12 THROUGH 17)3 D F L F 5 9 I 5 K J **A 0 0 0 0 1**

Sequence Number
A 00001 — A 99,999
B 00001 — B 99,999
and so on. . .

CY4167-1A

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EQUIPMENT CODES

INCOMPLETE VEHICLE MANUFACTURED BY
FORD MOTOR CO, S.A., DE C.V.
APARTADO POSTAL 39 BIS
MEXICO 1, D.F.GVWR:
VEHICLE IDENTIFICATION NUMBER

EXTERIOR PAINT COLORS

WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	DSO
158	F591		C	73		232

ESTD-18173-AA

F59 1

Series	Series Code	GVWR Code	GVWR (lb)	Wheelbase (in)
F-Super Duty Commercial Stripped Chassis	F59	1	16,000	158

CY4168-2A

GENERAL INFORMATION (Continued)

INCOMPLETE VEHICLE MANUFACTURED BY
FORD MOTOR CO, S.A., DE C.V.
APARTADO POSTAL 39 BIS
MEXICO 1, D.F.

GVWR:
VEHICLE IDENTIFICATION NUMBER

EXTERIOR PAINT COLORS

WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	DSO SPRING
158	F591		C	73		232



Code	Description
C	Manual — 5 Speed H.D. Overdrive (M50D-HD)

CY4169-1A

E9TD-18173-AA

INCOMPLETE VEHICLE MANUFACTURED BY
FORD MOTOR CO, S.A., DE C.V.
APARTADO POSTAL 39 BIS
MEXICO 1, D.F.

GVWR:
VEHICLE IDENTIFICATION NUMBER

EXTERIOR PAINT COLORS

WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	DSO SPRING
158	F591		C	73		232



Code	Capacity (lb)	Ratio
73	11,000	5.13

CY4170-1A

E9TD-18173-AA

INCOMPLETE VEHICLE MANUFACTURED BY
FORD MOTOR CO, S.A., DE C.V.
APARTADO POSTAL 39 BIS
MEXICO 1, D.F.

GVWR:
VEHICLE IDENTIFICATION NUMBER

EXTERIOR PAINT COLORS

WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	DSO SPRING
158	F591		C	73		232

Aux./Opt. Usage Code (Front) — 2 3 2
Front Spring Code — 2 3 2
Aux./Opt. Usage Code (Rear) — 2 3 2
Rear Spring Code — 2 3 2

F-SUPER DUTY — STRIPPED CHASSIS
AUX./OPT. REAR SPRING USAGE CODE

Code	Description
3	Heavy Duty Rear Suspension Package

F-SUPER DUTY — STRIPPED CHASSIS REAR
SPRING CODES

Code	Part Number
2	E9TD-5560-BD

F-SUPER DUTY — STRIPPED CHASSIS
FRONT SPRING CODES

Code	Part Number
2	E9TD-5310-BB

CY4171-2A

E9TD-18173-AA

GENERAL INFORMATION (Continued)

INCOMPLETE VEHICLE MANUFACTURED BY
FORD MOTOR CO, S.A., DE C.V.
APARTADO POSTAL 39 BIS
MEXICO 1, D.F.

GVWR:
VEHICLE IDENTIFICATION NUMBER

E9TD-18173-AA

21

EXTERIOR PAINT COLORS

WB	TYPE GVW	BODY	TRANS	AXLE	TAPE	DSO SPRING
158	F591		C	73		232

DSO — FSO — PTO (DOMESTIC, FOREIGN AND SPECIAL ORDER)

The D.S.O. space will show a two-digit code number of the district which ordered the unit (see chart below). This code will appear on all units — domestic or export. If unit is built on a D.S.O., F.S.O., P.T.O. (special orders), the complete order number is under the D.S.O. spacer after the district code number.

Code	District
11	Boston
12	Buffalo
13	New York
14	Pittsburgh
16	Philadelphia
17	Washington
21	Atlanta
22	Charlotte
23	Memphis
24	Jacksonville

Code	District
26	New Orleans
28	Louisville
41	Chicago
42	Cleveland
43	Milwaukee
46	Indianapolis
47	Cincinnati
48	Detroit
52	Dallas
53	Kansas City

Code	District
54	Omaha
55	St. Louis
57	Houston
58	Twin Cities
71	Los Angeles
72	San Jose
74	Seattle
75	Phoenix
76	Denver
83	Government

Code	District
84	Home Office Reserve
85	American Red Cross
86	Recreation Vehicles
87	Body Company
89	Transportation Services
90's	Export
00	Special

CY4172-2A

Ford Motor Company

SECTION 10-02 Maintenance

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	10-02-1		

DESCRIPTION

For scheduled and non-scheduled maintenance on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 10-02, Maintenance in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

MAINTENANCE

Scheduled Maintenance

Emissions	10-02-1
Maintenance Schedule "E" (Emissions Systems)	10-02-6
Maintenance Schedule "E" (Non-Emissions Systems)	10-02-9
Owner Maintenance Checks	10-02-10

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SECTION 10-03 Lubrication Chart and Lubricant Specifications

SUBJECT	PAGE	SUBJECT	PAGE
LUBRICANT CHART		SPECIFICATIONS	10-03-4
Lubrication Charts	10-03-1		

LUBRICATION CHARTS

Lubrication Charts

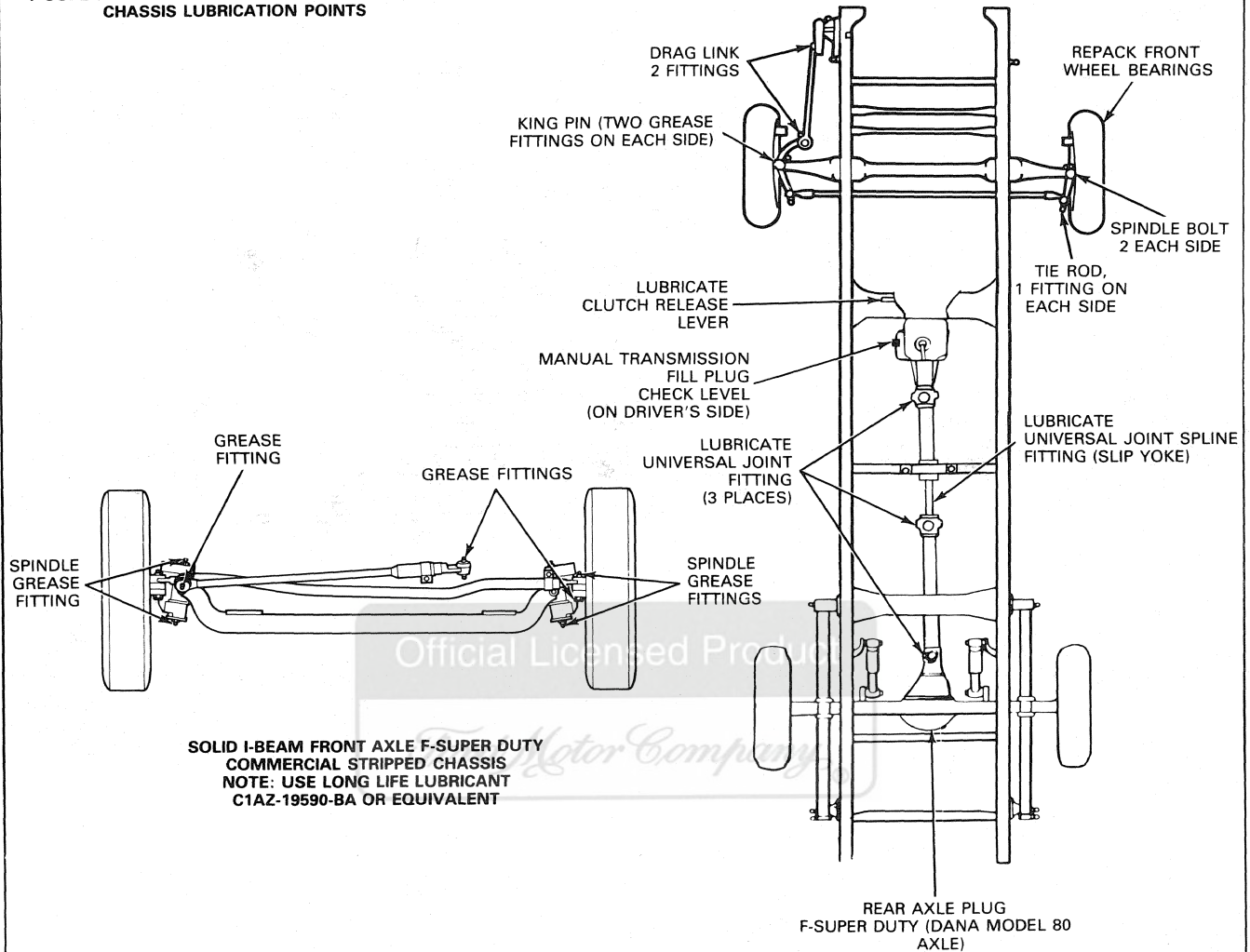
Important lubrication points for typical chassis and engines are shown in the following illustrations. Vehicles with optional equipment may have slightly different or additional lubrication points. When special equipment or accessories are installed on the truck, consult the manufacturer's literature for lubrication procedures. A table of recommended lubricants is included at the end of this Section.

WARNING: THE AMERICAN PETROLEUM INSTITUTE (API) HAS ANNOUNCED THAT CONTINUOUS CONTACT WITH USED MOTOR OIL HAS CAUSED SKIN CANCER IN LABORATORY MICE. THE EFFECTS OF USED MOTOR OIL ON HUMANS HAS NOT BEEN ESTABLISHED. IT IS RECOMMENDED, HOWEVER, THAT AS A PRECAUTIONARY MEASURE, HUMANS PROTECT THEIR SKIN BY WASHING WITH SOAP AND WATER AFTER COMING IN CONTACT WITH USED MOTOR OIL.

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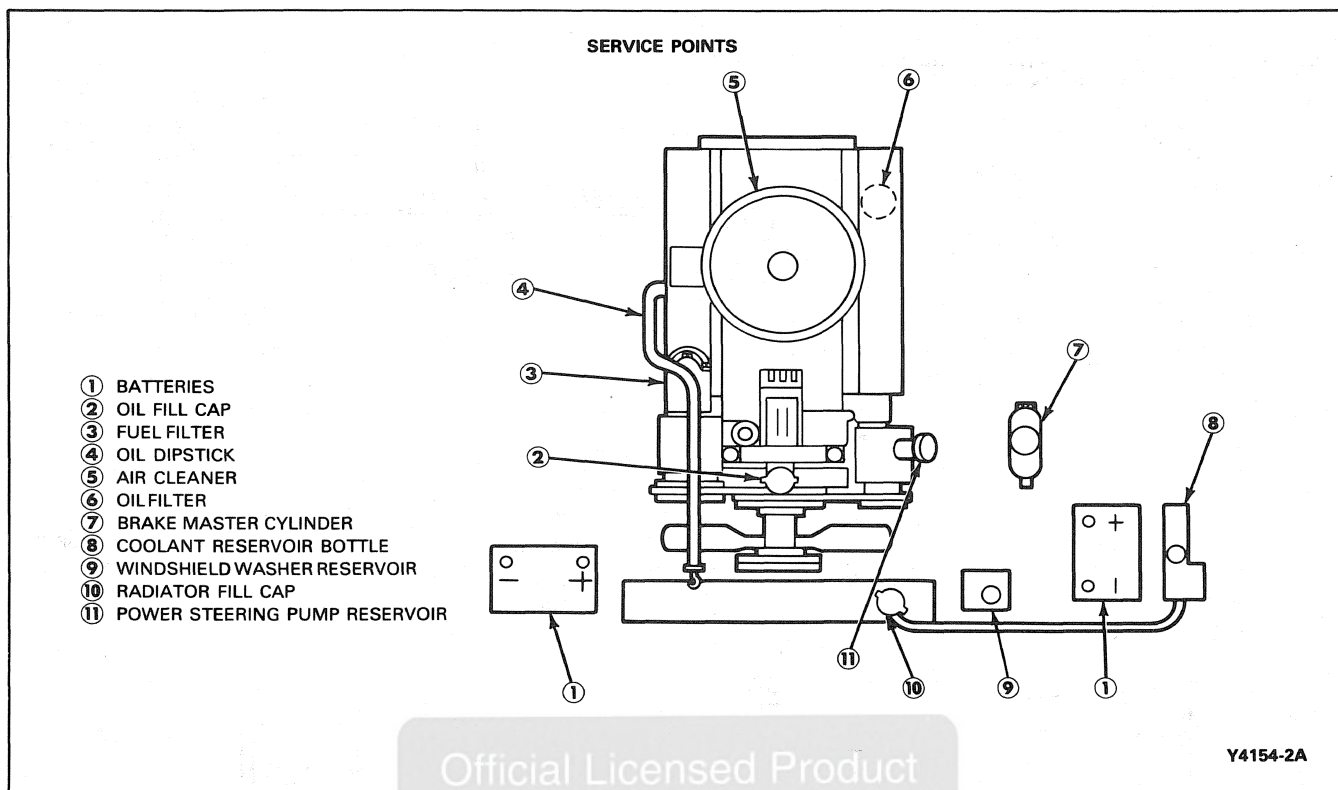
Ford Motor Company

LUBRICATION CHARTS (Continued)

F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS
CHASSIS LUBRICATION POINTS

Y4153-2A

LUBRICATION CHARTS (Continued)

*Ford Motor Company*

SPECIFICATIONS

LUBRICANT SPECIFICATIONS — F-Super Duty Commercial Stripped Chassis

Item	Ford Part Name	Ford Part Number	Ford Specification
Windshield Washer Reservoir	Ultra-Clear Windshield Washer Solvent	C9AZ-19550-AA or BA	ESR-M17P5-A
Body Hinges, Latches, Door Striker Plates and Rotor, Seat Tracks, Door Tracks and Checks, Hood Latch and Auxiliary Latch, Spare Tire Carrier Latch	Multi-Purpose Grease	D7AZ-19584-AA	ESR-M1C159-A
Lock Cylinders, Outside Spare Tire Lock	Lock Lubricant	D8AZ-19587-A	ESB-M2C20-A
Front Axle Spindle Pins, Steering Column U-Joints, Clutch Linkage Fittings, Parking Brake Linkage Pivots and Clevises, Transmission Control Linkage Pivots	Long-Life Lubricant	C1AZ-19590-BA	ESA-M1C75-B
Front Wheel Bearings and Rear Wheel Bearings Brake and Clutch Pedal Shaft, Front Drive Axle, Spindle Needle Bearings	Long-Life Lubricant	C1AZ-19590-BA	ESA-M1C75-B
Power Steering Reservoir	Motorcraft MERCON®	E4AZ-19582-B	ESP-M2C138-CJ
Clutch Release Lever at Pivots	Long-Life Lubricant	C1AZ-19590-BA	ESA-M1C75-B
Engine Oil — Diesel ^② (Consult respective engine owners guide for recommendations)	Motorcraft Motor Oil 15W40 Super Duty SAE-30 Super Duty	XO-15W40-QSD XO-30-QSD	API SF/CD and ESE-M2C153-D
Engine Oil Filter — Diesel	Oil Filter	E3TZ-6731-A (FL-784)	—
Speedometer, Parking Brake Cable	Speedometer Cable Lubricant	D2AZ-19581-A	ESF-M1C160-A
Steering Linkage — Lubricate only where equipped with grease fittings	Long-Life Lubricant	C1AZ-19590-BA	ESA-M1C75-B
Accelerator Linkage — Ball Socket	Long-Life Lubricant	C1AZ-19590-BA	ESA-M1C75-B
Front and/or Rear Dana Axles and Dana Limited Slip Rear Axles ^①	Rear Axle Lubricant	C6AZ-19580-E	ESW-M2C105-A
5-Speed Manual Overdrive Transmission ZF(S5-42)	Motorcraft MERCON®	E4AZ-19582-B	ESP-M2C138-CJ
Disc Brake, Caliper Rails	Disc Brake Caliper Slide Grease	D7AZ-19590-A	ESA-M1C172-A
F-Super Duty Parking Brake	MERCON®	E4AZ-19582-B	ESP-M2C138-CJ

① Add EST-M2C118-A (Friction Modifier Part No. C8AZ-19B546-A) or equivalent to refill Dana limited slip axles.

② For arctic winter operation below -25°C (-10°F) but not above -7°C (20°F), use engine oil SAE 5W-30 or SF/CD.

CY4155-2A

LUBRICANT SPECIFICATIONS — F-Super Duty Commercial Stripped Chassis (Cont.)

Item	Ford Part Name	Ford Part Number	Ford Specification
Hydraulic Brake Master Cylinder — Hydraulic Clutch Master Cylinder ^③	Heavy-Duty Brake Fluid	C6AZ-19542-AA or BA	ESA-M6C25-A
Brake and Clutch Pedal Pivots and Clevises	Engine Oil SAE-10W	—	ESE-M2C153-D API-SF
Driveshaft, Universal Joints and Slip Yoke	High Temperature Grease NLGI, No. 2		ESL-M1C173-A
Exhaust Control Valve	Rust Penetrant and Inhibitor	D7AZ-19A501-A	ESR-M99C56-A
Engine Coolant	Premium Cooling System Fluid	E2FZ-19549-AA	ESE-M97B44-A
Door Weatherstrips	Silicone Lube	C0AZ-19553-AA	ESR-M13P4-A

③ As the clutch disc wears, the fluid level in the reservoir will rise. Fluid level above the "step" is an indication of disc wear, NOT overfill.

CY4156-2A

SECTION 10-04 Towing

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	10-02-1		

DESCRIPTION

For towing procedures on F-Super Duty Commercial Stripped Chassis vehicles refer to the body manufacturers recommendations. For general towing practices, refer to the following pages in Section 10-04, Towing in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

TOWING

General Wrecker Towing

Procedure 10-04-1

Towing Slings/Chains/Hooks 10-04-2

TOWING CONNECTIONS — LIGHT TRUCK

Front Wheels Off Ground 10-04-3

Rear Wheels Off Ground 10-04-10

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SECTION 11-01 General Wheel and Tire Service

SUBJECT **PAGE**
DESCRIPTION 11-01-1

SUBJECT **PAGE**
SPECIFICATIONS 11-01-1

DESCRIPTION

For wheel and tire service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 11-01, General Wheel and Tire Service in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Front Wheel Bearing
 Maintenance 11-01-6
 Wheel and Tire Checking
 Procedure 11-01-3
 Wheel and Tire Vibration
 Diagnosis Procedures 11-01-6

DIAGNOSIS AND TESTING

Diagnosis Guides 11-01-3

MAINTENANCE

Front Wheel Bearings 11-01-8
 Rim and Wheel Maintenance 11-01-11
 Safety Precautions 11-01-11
 Tire Inflation 11-01-8
 Tire Maintenance 11-01-7
 Tire Rotation 11-01-8
 Tread Wear Indicators 11-01-8
 Wheels 11-01-6

SAFETY

Safety Precautions When
 Servicing Truck Tires 11-01-2

SERVICE

Off-Vehicle Balancing 11-01-12
 Tire and Wheel Balance 11-01-12
 Tire Replacement 11-01-11
 Tire Service 11-01-11
 Vibration 11-01-12

SPECIFICATIONS

WHEEL TORQUE SPECIFICATIONS

Vehicle	Wheel	Bolt Size	Torque *	
			N·m	Ft·Lb
F-Super Duty Commercial Stripped Chassis	10-Lug Wheel	9/16-18	190	140

* Torque specifications are for clean, dirt-and-paint-free dry bolt and nut threads. Never use oil or grease on studs or nuts.

CF6461-2A

WHEELS AND TIRES

Vehicle	Wheelbase	GVW	Wheel	Tire	Recommended Cold Inflation Pressure			
					PSI		kPa	
					Front	Rear	Front	Rear
F-Super Duty Commercial Stripped Chassis	158 inch	16,000	16 x 6	LT 235/85R 16E	80	80	552	552

CF6462-2A

ROTUNDA EQUIPMENT

Number	Description
084-00001	Truck Tire Changer
084-00002	Tire Spreader
007-00014	Radial Runout Gauge

CF3506-1D

SECTION 11-02 Wheels and Tires

SUBJECT **PAGE**
DESCRIPTION 11-02-1

SUBJECT **PAGE**
SPECIFICATIONS 11-02-1

DESCRIPTION

For wheel and tire service on F-Super Duty Commercial Stripped Chassis vehicles, refer to Section 11-02, Wheels and Tires in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

DESCRIPTION
 Front Wheel Assembly 11-02-1
 New Vehicle Break-in 11-02-1
 New Vehicle Break-in 11-02-1
 Rear Wheel Assembly 11-02-1

DIAGNOSIS AND TESTING 11-02-1

REMOVAL AND INSTALLATION
 Front Wheel Lug Nut Stud 11-02-5
 Front Wheel Replacement 11-02-2
 Lug Nut Torque Requirement 11-02-5
 Rear Wheel Lug Nut Stud 11-02-6
 Rear Wheel Replacement 11-02-3
 Tire Replacement Precautions 11-02-5
 Wheel Inspection and
 Maintenance 11-02-5

SPECIFICATIONS

WHEEL TORQUE SPECIFICATIONS

Vehicle	Wheel	Bolt Size	Torque *	
			N·m	Ft·Lb
F-Super Duty Commercial Stripped Chassis	10-Lug Wheel	9/16-18	190	140

* Torque specifications are for clean, dirt-and-paint-free dry bolt and nut threads. Never use oil or grease on studs or nuts.

CF6461-2A

SPECIAL SERVICE TOOLS

Number	Description
T74P-3044-A1	Wheel Stud Remover

CF5642-1A

ROTUNDA EQUIPMENT

Number	Description
084-00001	Tire Changer

CF3416-1D

SECTION 11-10 Wheels, Hubs and Bearings — Front

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DESCRIPTION	11-10-1
Wheel Bearing Adjustment	11-10-1	SPECIFICATIONS	11-10-2

DESCRIPTION

For wheel, hub and bearing service on F-Super Duty Commercial Stripped Chassis vehicle front axles, refer to the following pages in Section 11-10, Wheels, Hubs and Bearings — Front (Except Front Drive) in the 1988 Light

Truck Body/Chassis/Electrical Manual (Volume A):

REMOVAL AND INSTALLATION
Front Wheel Grease Seal and
Bearing 11-10-2

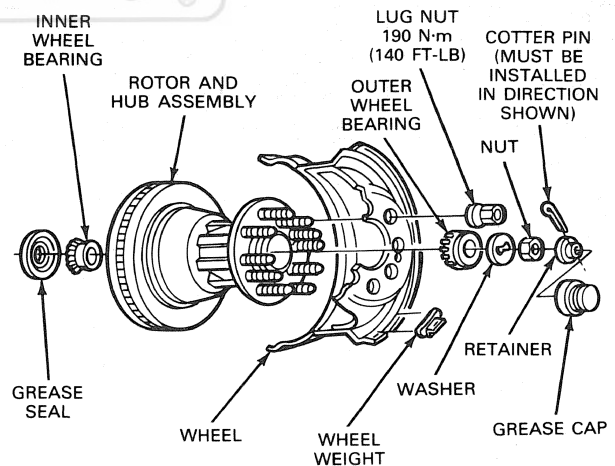
ADJUSTMENTS

Wheel Bearing Adjustment

To check the wheel bearing adjustment, raise the front of the vehicle. Then, grasp the tire at the sides, and alternately push inward and pull outward on the tire. If any looseness is felt, adjust the front wheel bearings.

1. Raise the vehicle until the tire clears the floor and install safety stands.
2. Remove the wheel cover. Remove the grease cap from the hub.
3. Wipe the excess grease from the end of the spindle. Remove the cotter pin and locknut.
4. Loosen the adjusting nut three turns. Attempt to obtain running clearance between the rotor brake surface and the shoe/linings by rocking the wheel, hub and rotor assembly in and out several times to push the shoe and linings away from the rotor, or by light tapping on the caliper housing or some other means that does not damage the rotor lining surfaces. **DO NOT PRY ON THE CALIPER PHENOLIC PISTON.** If running clearance cannot be maintained throughout

bearing adjustment in Steps 5 and 6, the caliper must be removed. Refer to Section 12-24, Disc Brakes — Light and Heavy Duty — Sliding Caliper, in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A).



F6464-1A

ADJUSTMENTS (Continued)

5. Tighten the wheel bearing adjusting nut to 23-34 N•m (17-25 ft-lb) while rotating the disc brake rotor in the opposite direction.
6. Back the nut off approximately 120° to 180°.
7. Tighten the nut to 2.03-2.26 N•m (18-20 in-lb) while rotating the disc brake rotor.
 - End play should be .006-.127 mm (.00025-.005 inch).
 - Torque required to rotate the hub should be 1.13-2.82 N•m (10-25 in-lb).
8. Install the retainer, new cotter pin, and grease cap.
9. Install the caliper (if removed).
10. Install the wheel and tire assembly.
11. Lower the vehicle and tighten the lug nuts to 190 N•m (140 ft-lb).
12. Install the wheel cover or hub cap, if so equipped.
13. Before driving the vehicle, pump the brake pedal several times to restore normal braking action.
14. After 800 kilometers (500 miles) of operation, retighten the lug nuts to specifications. Failure to retighten the lug nuts could result in the wheel coming off while the vehicle is in motion.

SPECIFICATIONS

WHEEL TORQUE SPECIFICATIONS

Vehicle	Wheel	Bolt Size	Torque *	
			N•m	Ft-Lb
F-Super Duty Commercial Stripped Chassis	10-Lug Wheel	9/16-18	190	140

* Torque specifications are for clean, dirt-and-paint-free dry bolt and nut threads. Never use oil or grease on studs or nuts.

CF6461-2A

ROTUNDA EQUIPMENT

Number	Description	Application
108-00074	Wheel Bearing Packer	Up to 4" Bearings
108-00076	Wheel Bearing Packer	Up to 6" Bearings
091-00001	Brake and Clutch Service Vacuum	—

CF6466-2A

SECTION 11-14 Wheel Hubs and Bearings — Rear Dana Full Floating Axle

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DESCRIPTION	11-14-1
Wheel Bearing Adjustment	11-14-1	SPECIFICATIONS	11-14-2

DESCRIPTION

For wheel hub and bearing service on Dana full floating rear axles for F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 11-14, Wheel Hubs and Bearings — Rear Dana Full Floating Axle in the

1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

DESCRIPTION 11-14-1

DISASSEMBLY AND ASSEMBLY

Bearing, Cups and Seals 11-14-1

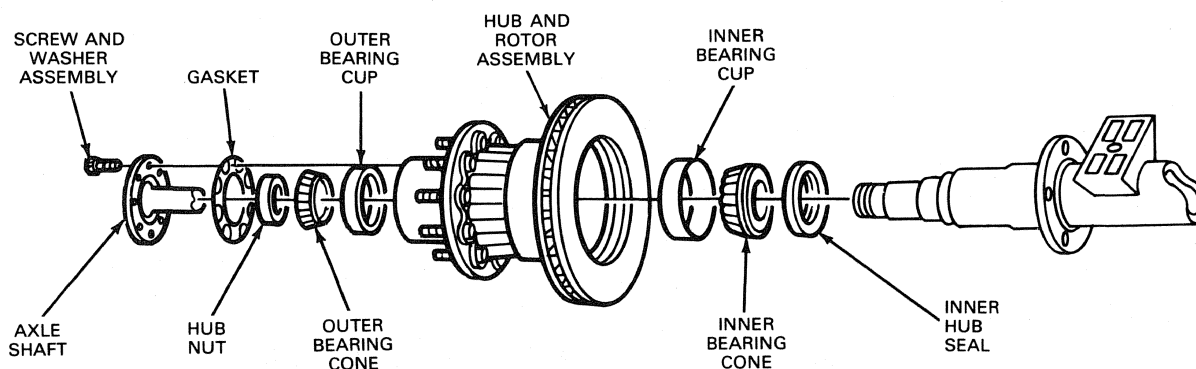
ADJUSTMENTS

Wheel Bearing Adjustment

- Using Hub Wrench T88T-4552-A or equivalent tighten the hub nut to 95 N·m (70 ft-lb) while rotating the hub.
- Loosen the hub nut at least 90° (1/4 turn).

- Tighten the hub nut to 20-27 N·m (27-36 ft-lb) while rotating the hub to give zero end play.

- Maximum torque to rotate the hub should be 4.5-5.6 N·m (40-50 in-lb).
- If necessary re-adjust to give required end play.



F6467-2A

SPECIFICATIONS**SPECIAL SERVICE TOOLS**

Number	Description
T88T-1175-A	Hub Outer Bearing Cup Remover
T88T-1175-B	Hub Inner Bearing Cup Remover
D80T-4200-H	Hub Inner Bearing Cup Replacer
T88T-1175-C	Hub Outer Bearing Cup Replacer
T88T-1175-D	Hub Seal Replacer
T88T-4252-A	Hub Wrench
T75T-1176-A	Threaded Drawbar
D79T-4000-A	Outside Thread Chaser

CF6468-1A

ROTUNDA EQUIPMENT

Number	Description
014-00030	Heavy Duty Wheel Dolly
108-00078	Bearing Packer

CF3417-1C

Official Licensed Product

Ford Motor Company

SECTION 12-01 General Hydraulic Brake Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	12-01-1	SPECIFICATIONS	12-01-1

DESCRIPTION

F-Super Duty Commercial Stripped Chassis vehicles are equipped with hydraulic disc brakes for both the front and the rear brakes. For hydraulic brake service on these vehicles, refer to the following pages in Section 12-01, General Hydraulic Brake Service in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Brake Hose	12-01-18
Brake Pedal Adjustment	12-01-10
Brake Tube	12-01-16
Flaring a Line (Flaring-Bar Type)	12-01-18
Flaring a Line (Split-Die Type)	12-01-16
Front Disc Brakes	12-01-10
Hydraulic Line Repair	12-01-15
Hydraulic System Bleeding	12-01-13
Pressure Bleeding — Dual Brake System Hydraulic Master Cylinder	12-01-13
Rear Disc Brakes	12-01-10

DESCRIPTION AND OPERATION

Disc Brakes	12-01-2
Dual Master Cylinder Brake System	12-01-2

DIAGNOSIS AND TESTING

Brake System Preliminary Checks	12-01-5
Diagnosis Guides	12-01-6
Dual Brake Warning light System Tests	12-01-5
Hydraulic Leak Test	12-01-5
Master Cylinder	12-01-6

OVERHAUL

Front Disc Brakes	12-01-20
Master Cylinder	12-01-21
Rear Disc Brakes	12-01-21

SAFETY

Breathing Asbestos Dust	12-01-3
-------------------------------	---------

SPECIFICATIONS

ROTUNDA EQUIPMENT

Model Number	Description
104-00064	Brake Bleeder
091-00001	Brake and Clutch Service Vacuum
065-00016	Brake Parts Washer

CH6801-1A

SPECIAL TOOLS

Number	Description	Application
T73L-2196-A	Disc Brake Piston Remover	Use with Slide Hammer
D79L-2196-A	Disc Brake Pad Spreader	Universal
TOOL-4201-C	Dial Indicator	Universal

CH6802-2A

SECTION 12-24 Disc Brakes — Heavy Duty — Sliding Caliper

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	12-24-1	SPECIFICATIONS	12-24-1

DESCRIPTION

F-Super Duty Commercial Stripped Chassis vehicles are equipped with dual piston, heavy duty pin rail slider calipers on front and rear axles. For disc brake service on these vehicles, refer to the following pages in Section 12-24, Disc Brakes — Light and Heavy Duty — Sliding Caliper in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Disc Brake Shoe Adjustments	12-24-6
Hydraulic System Bleeding	12-24-6

DIAGNOSIS AND TESTING

Disc Brake Rotor	12-24-2
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DISASSEMBLY AND ASSEMBLY

Disc Brake Caliper — HD Rail Sliding Caliper	12-24-11
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REMOVAL AND INSTALLATION

Disc Brake Hub and Rotor	12-24-10
Heavy Duty Pin Rail Slider Caliper, Brake Shoes and Linings	12-24-8
Hydraulic Line Repair	12-24-11

SAFETY

Breathing Asbestos Dust	12-24-7
-------------------------------	---------

SPECIFICATIONS

ROTUNDA EQUIPMENT

Model Number	Description
104-00064	Brake Bleeder
091-00001	Asbestos Vacuum
065-00016	Brake Parts Washer

CH3539-1E

SPECIAL SERVICE TOOLS

Number	Description	Application
T50T-100-A	Impact Slide Hammer — 2-1/2 lb.	Universal
D79P-100-A	Impact Slide Hammer — 5 lb.	Universal
T59L-100-B	Impact Slide Hammer - 2-1/2 lb.	Universal
T71P-1102-A	Disc Rotor Surface Gauge	Universal
T73L-2196-A	Disc Brake Piston Remover	Use with Slide Hammer
D79L-2196-A	Disc Brake Pad Spreader	Universal
TOOL-4201-C	Dial Indicator with Bracketry	Universal

CH6803-2A

SPECIFICATIONS (Continued)

TORQUE LIMITS — HYDRAULIC NUTS (FT-LB)

Thread Size	N·m	(Ft-Lb)①
3/8-24	14-20	10-15
7/16-24	14-20	10-15
1/2-20	14-23	10-17
9/16-18	14-23	10-17

① All hydraulic line connections (nuts) must be tightened to the specified value and free of fluid leakage.

CH6804-1A

TORQUE LIMITS

Description	N·m	(ft-lb)
Brake Hose to Caliper Attaching Bolt	24-33	17-25

CH6805-1A

ROTOR REPAIR DIMENSIONS — F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS

Minimum Rotor Thickness (Discard Thickness)		Rotor Thickness Maximum Variation		Brake Surface Lateral Runout (Maximum)		Rotor Surface Finish
MM	Inch	MM	Inch	MM	Inch	Micro-Inches
36.3	1.43	0.025	0.0010	0.20	0.008	15-80

CH6806-2A

Official Licensed Product



SECTION 12-57 Hydro-Boost Brake Booster

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	12-57-1	SPECIFICATIONS	12-57-3
REMOVAL AND INSTALLATION	12-57-2		

DESCRIPTION

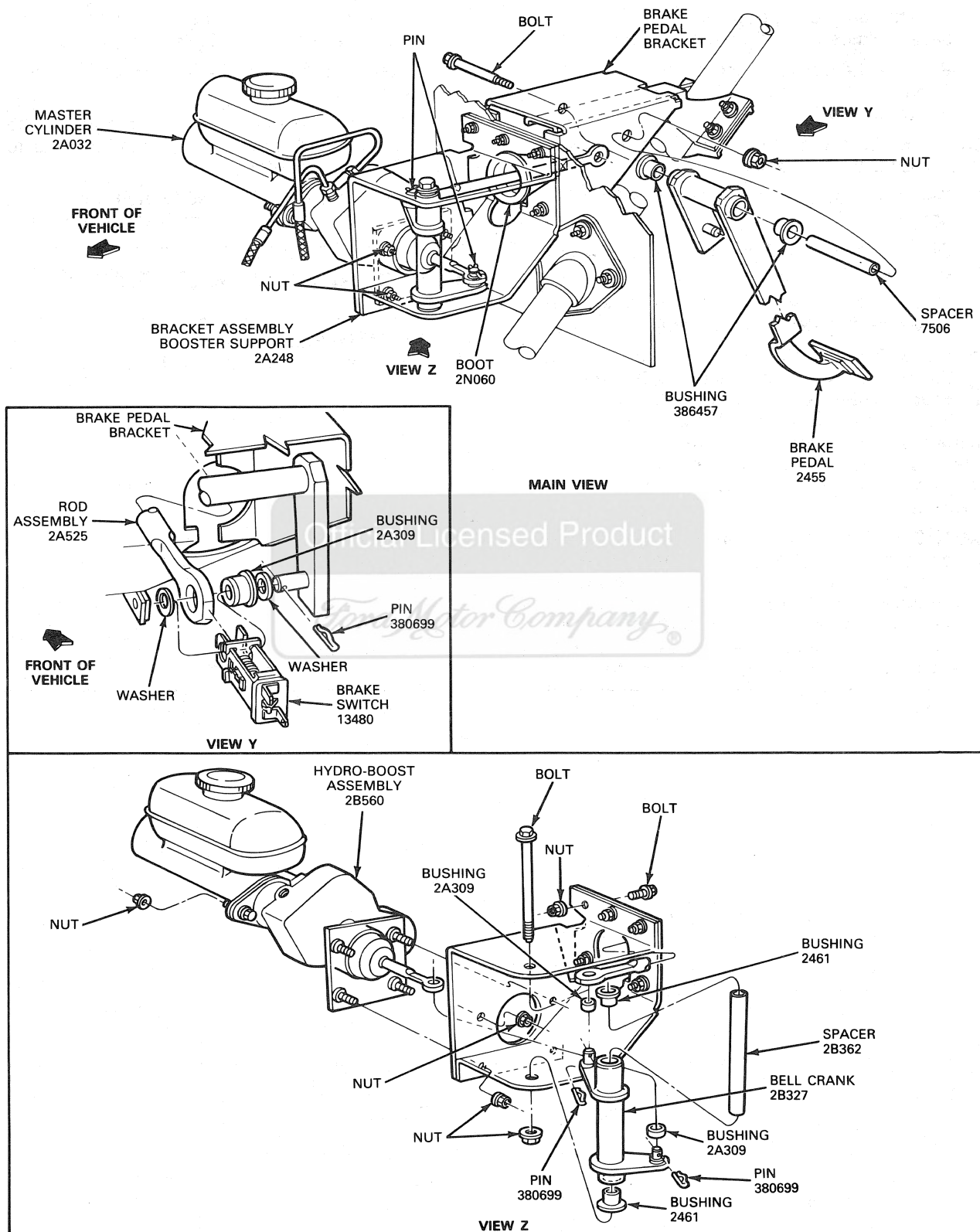
F-Super Duty Commercial Stripped Chassis vehicles are equipped with the Bendix Hydro-Boost hydraulic brake booster. For hydraulic brake booster service on these vehicles, refer to the following pages in Section 12-57, Hydro-Boost Brake Booster in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS	12-57-11
DESCRIPTION AND OPERATION	
Description	12-57-1
Operation	12-57-4
DIAGNOSIS AND TESTING	
Diagnosis Guides	12-57-8
Hydro-Boost Normal Noise	
Characteristics	12-57-7
DISASSEMBLY AND ASSEMBLY	12-57-12

Official Licensed Product

Ford Motor Company

REMOVAL AND INSTALLATION



REMOVAL AND INSTALLATION (Continued)

Removal

1. With the engine off, depress the brake pedal several times to discharge the accumulator.
2. Remove the master cylinder from the Hydro-Boost unit. Prop the master cylinder up and out of the way.

CAUTION: Do not apply the booster with the master cylinder removed.

3. Disconnect all three hydraulic lines from the booster.
4. Disconnect the input pushrod from the brake pedal assembly.
5. Remove the booster mounting nuts, and remove the booster from the vehicle.

CAUTION: The booster should not be carried by the accumulator, nor should it ever be dropped on the accumulator. The snap ring on the accumulator should be checked for proper seating before the booster is used. The accumulator contains high pressure nitrogen gas and can be dangerous if mishandled.

CAUTION: If the accumulator is to be disposed of it must not be exposed to excessive heat, fire or incineration. Before discarding the accumulator, drill a 1/16 inch diameter hole in the end of the accumulator can to relieve the gas pressure. Always wear safety glasses when performing this operation.

Installation

1. Install the booster in the vehicle and tighten the mounting nuts to 25-33 N·m (18-25 ft-lb).
2. Connect the input pushrod to the brake pedal assembly.
3. Position the master cylinder against the booster and tighten the mounting nuts to 25-33 N·m (18-25 ft-lb).
4. Connect the three hoses to the Hydro-Boost unit. Refill the system and bleed as required.

DISASSEMBLY AND ASSEMBLY

The Hydro-Boost power brake booster is not to be disassembled and is to be serviced as a unit.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Torque	
	N·m	Ft-Lb.
Booster Mounting Nuts	25-33	18-25
Booster Cover to Booster Body	30-32	22-24
Bracket to Booster Nut	149-155	110-114
Master Cylinder to Booster Nuts	25-33	18-25

CH6271-1A

SECTION 12-70 Parking Brake — Cable Actuated, Transmission Mounted

SUBJECT	PAGE
ADJUSTMENTS	12-70-2
DESCRIPTION	12-70-1

SUBJECT	PAGE
SPECIFICATIONS	12-70-3

DESCRIPTION

F-Super Duty Commercial Stripped Chassis vehicles are equipped with a transmission mounted parking brake that is cable actuated by an Orscheln lever. For parking brake service on these vehicles, refer to the following pages in Section 12-70, Parking Brake — Cable Actuated, Rear Wheels and Transmission Mounted in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

DIAGNOSIS AND TESTING 12-70-12

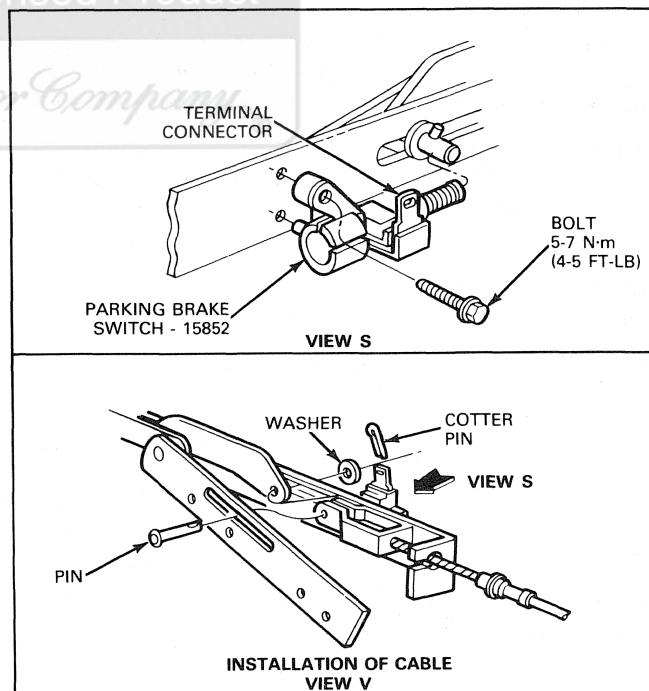
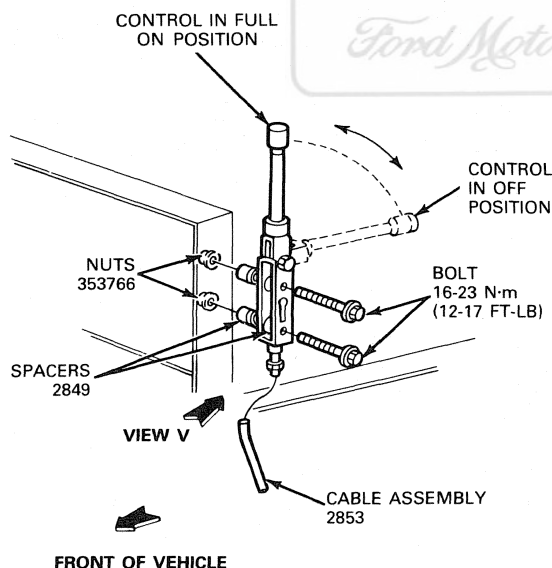
DISASSEMBLY AND ASSEMBLY

Brake Shoes 12-70-15

Transmission Mounted Parking
Brake 12-70-14

REMOVAL AND INSTALLATION

Transmission Mounted Parking
Brake Assembly 12-70-13



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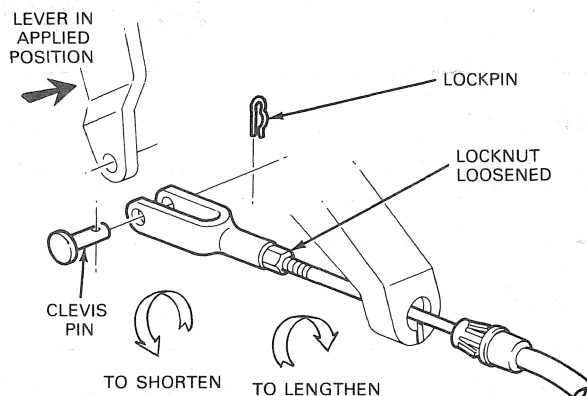
ADJUSTMENTS

Cable Actuated Transmission Mounted Parking Brake

Field Adjustment

Use this adjustment to correct excessive parking brake control pedal travel.

1. Raise the vehicle on a twin post hoist and install safety stands.
2. Place the transmission in neutral, and release the parking brake Orscheln lever.
3. Loosen the parking brake adjusting clevis jam nut several turns (spray the adjusting nut, threaded rod and the clevis with penetrating oil to ease adjustment).
4. Remove the locking pin and the clevis pin from the adjusting clevis.
5. While the lever is being held tight in the applied position, screw the clevis (clockwise) onto the threaded end of the cable until the clevis pin can be inserted freely into the clevis and the brake actuating lever while the lever is being held tight in the applied position, and the cable is tight.
6. Remove the clevis pin. Rotate the clevis 10 full turns in a counterclockwise (loosening) direction (about 1/2 inch). Install the clevis



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pin into position. Install the locking pin and tighten the clevis jam nut tight against the clevis. Recheck rotation of the driveshaft for freedom from drag.

7. Remove the safety stands and lower the vehicle down off the hoist.

SPECIFICATIONS

SPECIAL SERVICE TOOLS

Tool Number	Description
T88T-2598-G	Locknut Socket — 75mm
D80L-1002-L	2 — Jaw Puller
D79L-4621-A	Bearing Cone Remover
D80L-630-6	Step Plate
T77F-1102-A	Bearing Cup Puller
T88T-2598-D	Inner Bearing Cup Installer
T88T-2598-E	Outer Bearing Cup Installer
T88T-2598-C	Oil Seal Replacer
T88T-2598-F	Bearing Replacer
TOOL-4201-C	Dial Indicator with Bracketry

CH6311-1A

TRANSMISSION MOUNTED PARKING BRAKE — TORQUE SPECIFICATIONS

Description	N·m	Ft·Lb
Parking brake case to transmission bolts	34-58	25-43
Driveshaft to output flange	20-27	15-20
Brake backing plate to housing	118-122	87-91
Output yoke flange to brake drum	113-117	83-87
Mainshaft locknut	288-292	212-216
Vent to housing	12-16	8-12
Fill plug	59-63	43-47

CH6255-1A

SECTION 13-01 General Steering Service

SUBJECT **PAGE**
DESCRIPTION 13-01-1

SUBJECT **PAGE**
SPECIFICATIONS 13-01-1

DESCRIPTION

F-Super Duty Commercial Stripped Chassis vehicles are equipped with a C-300N hydraulic power steering gear, and ZF power steering pump. For general information on steering service refer to the following pages in Section 13-01, General Steering Service in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Clear Vision Adjustment 13-01-7

CLEANING AND INSPECTION

Power Steering Gear 13-01-7

DIAGNOSIS AND TESTING

Diagnosis Guides 13-01-7

External Leak Check 13-01-2

Fitting and O-ring Leak

Inspection 13-01-3

Fluid Level Check 13-01-2

Power Steering — Preliminary

Checks 13-01-1

Power Steering Tests 13-01-3

Pump Belt Check 13-01-1

Purging Power Steering System

of Air 13-01-6

Devac System 13-01-6

Start-up Procedure (After

Power Steering Pump or Gear

Overhaul) 13-01-6

SPECIFICATIONS

SPECIAL SERVICE TOOLS

Number	Description	Application
T63L-8620-A	Belt Tension Gauge	Universal
D79L-33610-A	Power Steering Pump Analyzer	All Vehicles

CG3681-2D

ROTUNDA EQUIPMENT

Number	Description
014-00207	Power Steering Analyzer

CG3682-1B

SECTION 13-06 Steering Column

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION	
Ignition Switch Adjustment	13-06-1	Steering Wheel	13-06-3
Switch Adjustment	13-06-2	Steering Column	13-06-4
Alignment for Clear Vision	13-06-2	Upper Shaft Bearing, Upper Flange, and	
DESCRIPTION	13-06-1	Shift Socket/Flange Extension	13-06-5
DIAGNOSIS AND TESTING	13-06-1	Column Lock Actuator and Steering	
DISASSEMBLY AND ASSEMBLY		Wheel Lock Pin	13-06-6
Steering Column	13-06-8	Ignition Lock Cylinder Assembly	13-06-6
Steering Column Flange and		Ignition Lock Drive Gear	13-06-8
Locking Mechanism		SPECIFICATIONS	13-06-11
Subassembly	13-06-10		

DESCRIPTION

The steering columns are attached to the steering gear by means of an intermediate shaft. The column design features a concentric outer tube, internal shift tube and steering shaft.

Features on the column include an emergency flasher switch and a turn signal indicating switch with lane change position.

DIAGNOSIS AND TESTING

Refer to Section 13-01, General Steering Service for diagnostic and testing procedures.

ADJUSTMENTS

Ignition Switch Adjustment

Correct Ignition Switch Operation

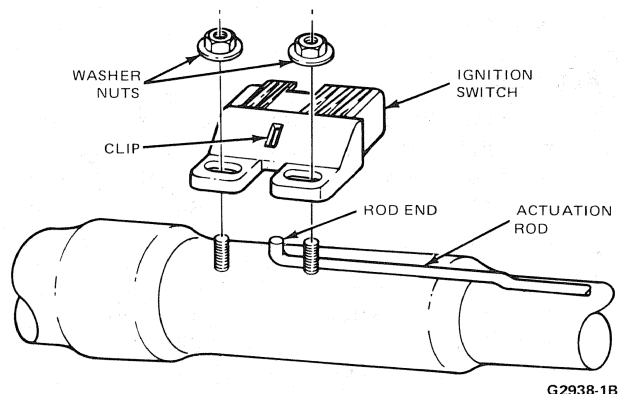
The ignition switch is actuated by a rod through the lock actuator rack and pinion driven by the key cylinder. Rotating the key clockwise from the full counterclockwise stop, the positions are: ACCESSORY, LOCK, OFF, ON, and START, if the switch is properly adjusted.

1. In ACCESSORY, the accessory circuits are operative.
2. In LOCK, all ignition switch electrical circuits are inoperative and the steering wheel and gear shift lever are locked.
3. In OFF, all ignition switch electrical circuits are inoperative and the steering wheel is unlocked for all gear shift lever positions.
4. In ON, all ignition switch circuits are operative except the starter circuit and the steering wheel is unlocked.
5. In START, the engine ignition and starter circuits only are operative and the steering wheel is unlocked.
6. The above functions are attainable regardless of direction of actuation.

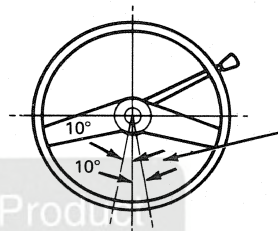
If the above operations are not acquired, adjust per procedure below.

ADJUSTMENTS (Continued)**Switch Adjustment**

1. Place the key in the ignition switch and rotate to LOCK Position.
2. Loosen the washer-nuts retaining the ignition switch to the steering column.
3. Align the clip hole in the ignition switch with the actuation rod end.
4. Center the switch on the actuation rod.
5. Tighten the washer nuts to 4.5-7.3 N·m (40-65 in-lbs) and remove the clip.
6. Check for correct ignition switch operation.

**Alignment For Clear Vision (Steering Wheel Spoke Alignment)**

1. Set wheels in straight ahead position by driving vehicle a short distance and mark the steering wheel relationship to steering column with a chalk mark.
2. If the steering wheel is more than 10 degrees off center, remove the steering wheel as described below and perform step 3.
3. The steering wheel has serrations equally spaced and can be installed in any position. Therefore with the front wheels in the straight ahead position, install the steering wheel on the column so that the spokes are



WHEEL CENTERLINE TO BE WITHIN 10° OF VERTICAL PLANE AFTER TOE IN IS ADJUSTED

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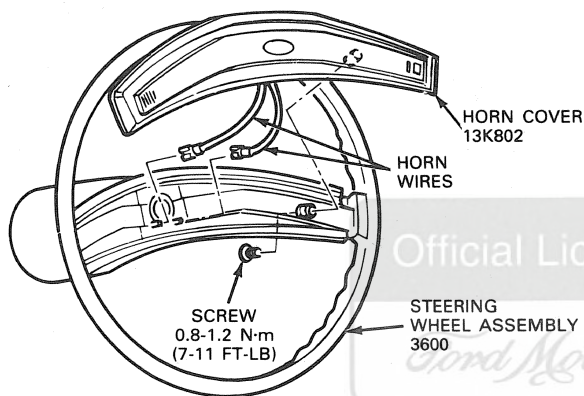
4. Install the steering wheel as described below.

REMOVAL AND INSTALLATION

Steering Wheel

Removal

1. Park the vehicle with the front wheels in the straight ahead position. Mark the steering wheel in relationship to the steering column with chalk or two pieces of tape.
2. Disconnect the battery ground cable.
3. Remove one screw from the underside of each steering wheel spoke, and lift the horn switch assembly (steering wheel pad) from the steering wheel.



G6540-1A

4. Disconnect the horn switch wires by pulling the spade terminal from the blade connectors.
5. Remove the horn switch assembly.
6. Remove steering wheel retaining nut.
7. Use the Steering Wheel Puller, T67L-3600-A or equivalent and remove steering wheel from shaft. Do not hammer on the steering wheel or center shaft or use a knock-off type steering wheel puller as either procedure will damage the steering column.

Installation

The steering wheel can be installed in any position. Therefore, with front wheels in the straight ahead position install the steering wheel on the steering column so the steering wheel is within 10 degrees plus or minus from horizontal.

Place the steering wheel on the steering column upper shaft, so that the mark and flat on the steering wheel is in line with the mark and flat on the steering column center shaft.

1. Install a steering wheel lock nut (389530-S2 or equivalent). Tighten the nut to 41-57 N·m (30-42 ft-lb).
2. Connect the horn wires.
3. Install the steering wheel horn cover pad. Tighten the screws to 0.8-1.2 N·m (7-11 in-lbs).
4. Connect the negative (–) battery cable to the terminal.
5. Test the steering column for proper operation.

REMOVAL AND INSTALLATION (Continued)

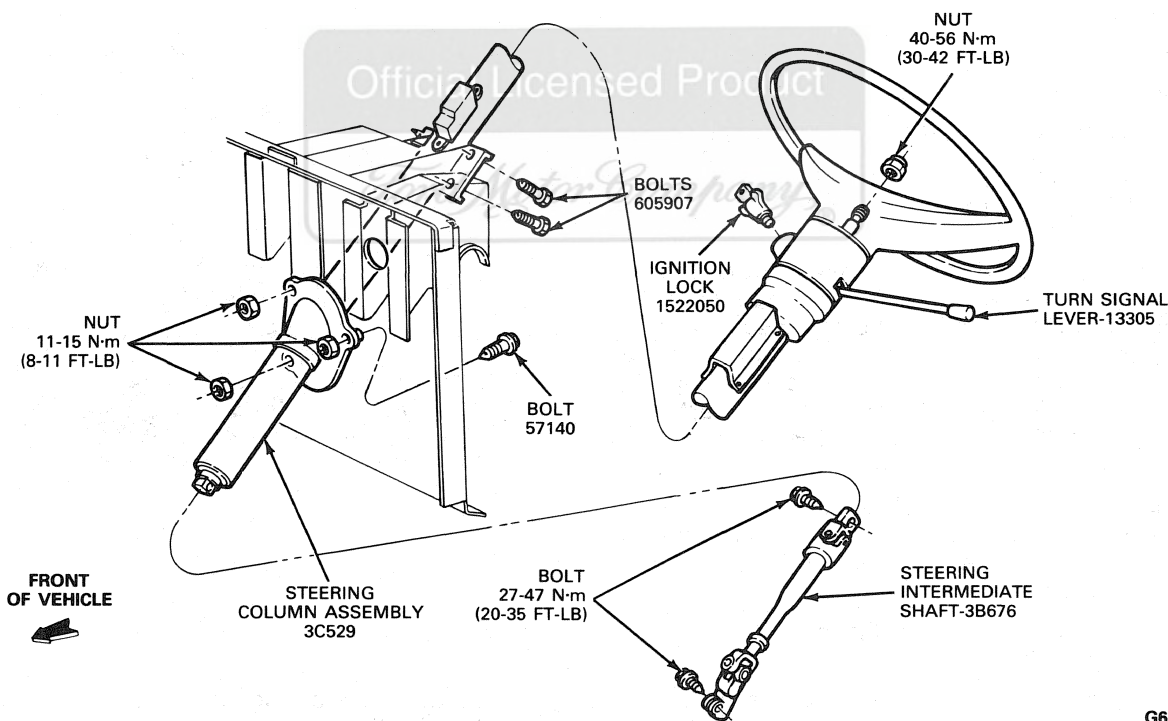
Steering Column

Removal

1. Park the vehicle with the wheels in a straight ahead position.
2. Disconnect the battery negative cable.
3. Remove the intermediate shaft to steering column shaft clamp bolt.
4. Remove the steering wheel as described above.
5. Disconnect the turn signal, hazard warning, ignition switch and horn wiring harness from the column.
6. Remove the steering column to floor pan cover plate retaining bolts.
7. Remove the steering column to steering column support bracket retaining bolts and remove the steering column from the vehicle.

Installation

1. Install the steering column in the vehicle and install the steering column support bracket retaining bolts.
2. Install the steering column to floor pan cover plate retaining bolts and tighten to 11-15 N·m (8-11 ft-lb).
3. Connect the horn, ignition, turn signal and hazard warning switch wires to the steering column.
4. Install the steering wheel and tighten the nut to 40-56 N·m (30-42 ft-lb).
5. Install the intermediate shaft to steering column clamp bolt and tighten to 27-47 N·m (20-35 ft-lb).
6. Connect the battery negative cable.
7. Check the steering for correct operation.



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REMOVAL AND INSTALLATION (Continued)

Upper Shaft Bearing, Upper Flange, and Shift Socket/Flange Extension

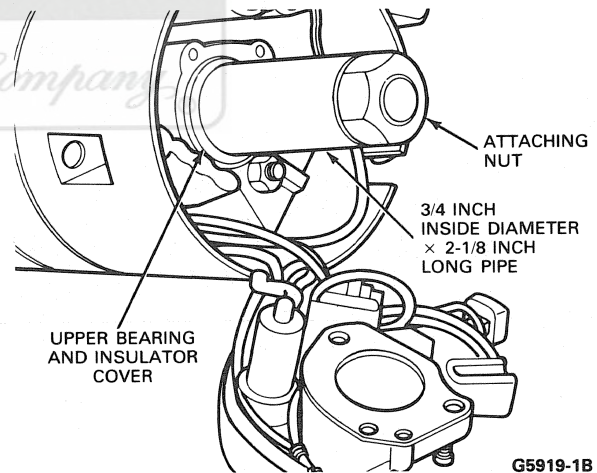
These components can be serviced without removing the column from the vehicle.

Removal

1. Set the parking brake.
2. Disconnect the battery cable from the negative terminal.
3. Remove the steering column shroud and instrument panel opening cover.
4. Disconnect the turn signal hazard warning and ignition switch electrical connections.
5. Clip the ignition switch in the LOCK position and remove the switch.
6. Remove the steering wheel as described in this Section.
7. Remove the turn signal lever.
8. Remove the screws from the turn signal hazard warning switch and slip the switch off the steering shaft.
9. Remove the snap ring from above the upper shaft bearing.
10. Loosen the nuts retaining the upper flange casting to the column until one or two threads on each remain engaged, pinching the nuts toward each other, withdraw the upper flange from the steering column. Some tapping on the steering shaft upper end with a light hammer may be required.
11. Remove the upper shaft bearing and insulator cover by driving out from the opposite side of the flange.
12. Remove the shift tube retaining screw at the bottom of the shift socket and withdraw the shift socket.
13. Remove the 3 flange extension retaining screws and remove the extension.

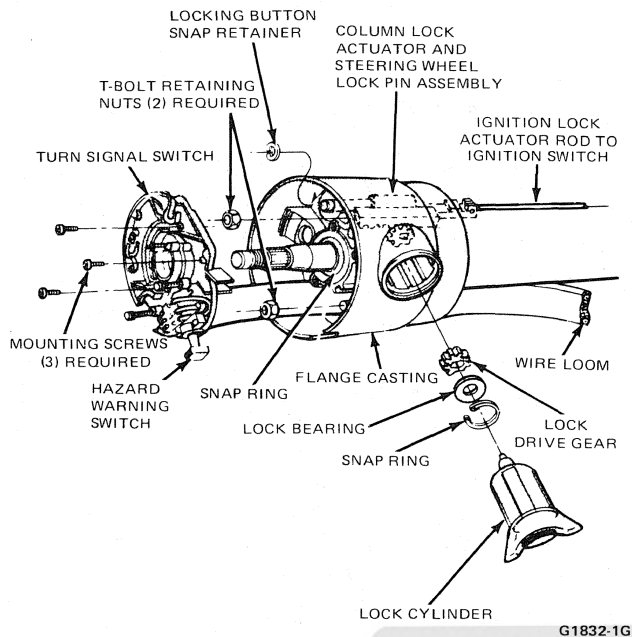
Installation

1. Install the shift socket/flange extension.
2. Place the flange on the steering column tube and tighten nuts to 6.8-8.5 N·m (60-75 in-lb).
3. Prick punch the steering shaft serration diameter to insure an interference fit to the inner face. Place the bearing and insulator on the shaft, working them as far down the shaft as possible. Place a piece of pipe 19.05mm (3/4 inch) (inside diameter) x 53-97mm (2 1/8 inch) long over the end of the shaft.
4. Install the steering wheel attaching nut. Tighten the nut until the bearing is seated in the flange. Remove the nut and pipe from the steering shaft.
5. Install the snap ring in the groove on the steering shaft.
6. Install the turn signal switch on the flange. Tighten the screws to 2.5-3.0 N·m (20-30 in-lbs).
7. Install the turn indicator lever.
8. Connect the electrical connections to the steering column.
9. Install the steering wheel as described in this Section.
10. Connect the negative battery cable to the terminal.
11. Test the steering column for proper operation.



REMOVAL AND INSTALLATION (Continued)

Column Lock Actuator and Steering Wheel Lock Pin



Removal

1. Remove the steering column shroud.
2. Remove the ignition lock drive gear as described in this Section.
3. Remove the attaching nuts that hold the steering column to brake pedal support.
4. Loosen the ignition switch attaching nuts and remove the ignition rod from the switch end.
5. Remove the upper shaft bearing as described in this Section.
6. Remove the ignition lock actuator rod and steering wheel lock pin assembly.
7. Remove and discard the retaining clip at the lower end of the steering wheel lock pin. Remove the steering wheel lock pin and lock pin spring from the ignition switch actuator. Do not lose the spring.

Installation

1. Install a new lock pin and clip, and the old lock pin spring in the actuator casing.
2. Place the column lock actuator and steering wheel lock pin in the steering column.
3. Engage actuator rod into ignition switch. Do not tighten switch retaining nuts.
4. Install the lock drive gear, lock bearing and snap ring.
5. Install the lock cylinder with the key in the ON position. Install with the retaining pin flush with cylinder. Turn key to the OFF position.
6. Install the upper shaft bearing as described in this Section.
7. Adjust the ignition switch as explained in this Section.
8. Secure the steering column to the brake pedal support.
9. Install the trim shroud.

Ignition Lock Cylinder Assembly

NOTE: The following procedure pertains to vehicles that have functional lock cylinders and ignition keys are available or the ignition key numbers are known and the proper key can be made:

Removal

1. Disconnect the battery ground cable.
2. Remove the horn button and the steering wheel as described earlier in this Section.
3. Place the gear shift in any position and turn the lock cylinder with the ignition key to ON position.
4. Place 1/8 inch diameter wire pin or small drift punch in the hole located inside the column near the base of the lock cylinder housing and depress the retaining pin while pulling out on the lock cylinder to remove it from the column housing.

Installation

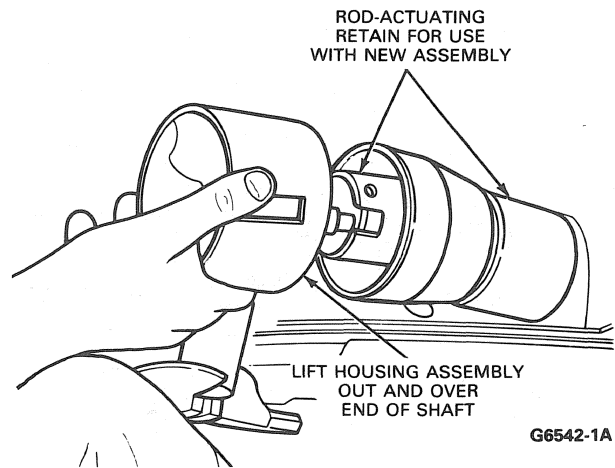
1. To install the lock cylinder, turn the lock cylinder to the ON position and depress the retaining pin, then insert the lock cylinder into its housing in the flange casting. Assure that the cylinder is fully seated and aligned into the interlocking washer before turning the key to the OFF position. This action will permit the cylinder retaining pin to extend into the cylinder cast housing hole.
2. Using the ignition key rotate the lock cylinder to insure correct mechanical operation in all positions.
3. Install the steering wheel and trim pads as described earlier in this Section.
4. Connect the battery ground cable.

REMOVAL AND INSTALLATION (Continued)

NOTE: The following procedure applies to vehicles where the ignition lock is inoperative and the lock cylinder cannot be rotated due to a lost or broken ignition key and the key number not known or the lock cylinder cap is damaged and/or broken to the extent that the lock cylinder cannot be rotated:

Removal

1. Disconnect the battery ground cable.
2. Remove the horn button and steering wheel as described earlier in this Section.
3. Remove the turn signal lever from the steering column.
4. To gain access to the ignition switch remove the steering column trim shrouds from the steering column. Detach and lower the steering column assembly from the brake pedal support bracket as described earlier in this Section.
5. Remove the ignition switch and pin it in the LOCK position.
6. Remove the turn signal switch from the column assembly as described in this Section under Manual Key Release Button and Lever in the Removal and Installation Section.
7. Remove the upper bearing snap ring and the (2) T-bolt retaining nuts that secure the flange casting to the outer tube. Remove the entire flange casting assembly, the upper shaft bearing, the lock cylinder assembly, the ignition switch actuator and the ignition switch actuator rod by pulling the assembly over the end of the steering column shaft.



8. Replace the above assembly with a new assembly consisting of:
 - (1) 3511 Flange
 - (1) 11582 Lock Cylinder Assembly
 - (1) 3E717 Lock Gear, Steering Column Lock
 - (1) 3E700 Bearing, Steering Column Lock
 - (1) 3C610 Retainer, Steering column Upper Bearing
 - (1) 3E723 Actuator Assembly, Steering Column Lock

NOTE: Retain the ignition switch actuating rod from the removed casting assembly and use it with the new flange casting assembly.

Installation

1. Reassemble the above parts, installing a new upper shaft bearing (3517) and set the actuator to drive gear as described earlier in this Section.
2. Install the turn signal switch as described earlier in this Section.
3. Install the ignition switch, check and/or adjust for proper function as specified in this Section.
4. Install the instrument cluster.
5. Install the steering column trim shrouds, steering wheel and pad assembly as specified earlier in this Section.
6. Install the turn signal lever.
7. Using the ignition key rotate the lock cylinder to insure correct mechanical operation in all positions.
8. Connect the battery ground cable.

REMOVAL AND INSTALLATION (Continued)

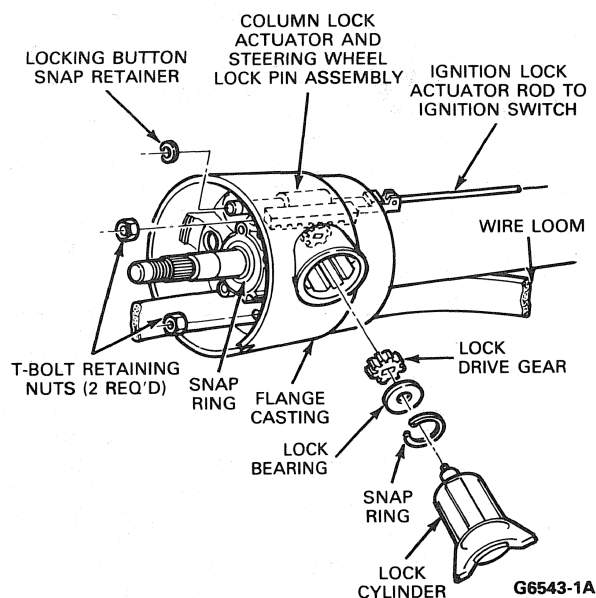
Ignition Lock Drive Gear

Removal

1. Remove the lock cylinder assembly as detailed in this Section.
2. Insert a flat bladed screwdriver in the recess of the drive gear at the bottom of the lock cylinder housing. Turn the lock drive gear counterclockwise three notches.
3. Remove the snap ring, washer and lock drive gear from the lock cylinder housing. Note the position of the drive gear to the rack teeth.

Installation

1. Install the lock drive gear in the housing in the same position as noted during removal. Installation is correct if the last tooth on the drive gear is meshed with the last tooth on the rack. Install the washer and snap ring.
2. Using the screwdriver blade, turn the drive gear clockwise three notches.
3. Install the lock cylinder.



DISASSEMBLY AND ASSEMBLY

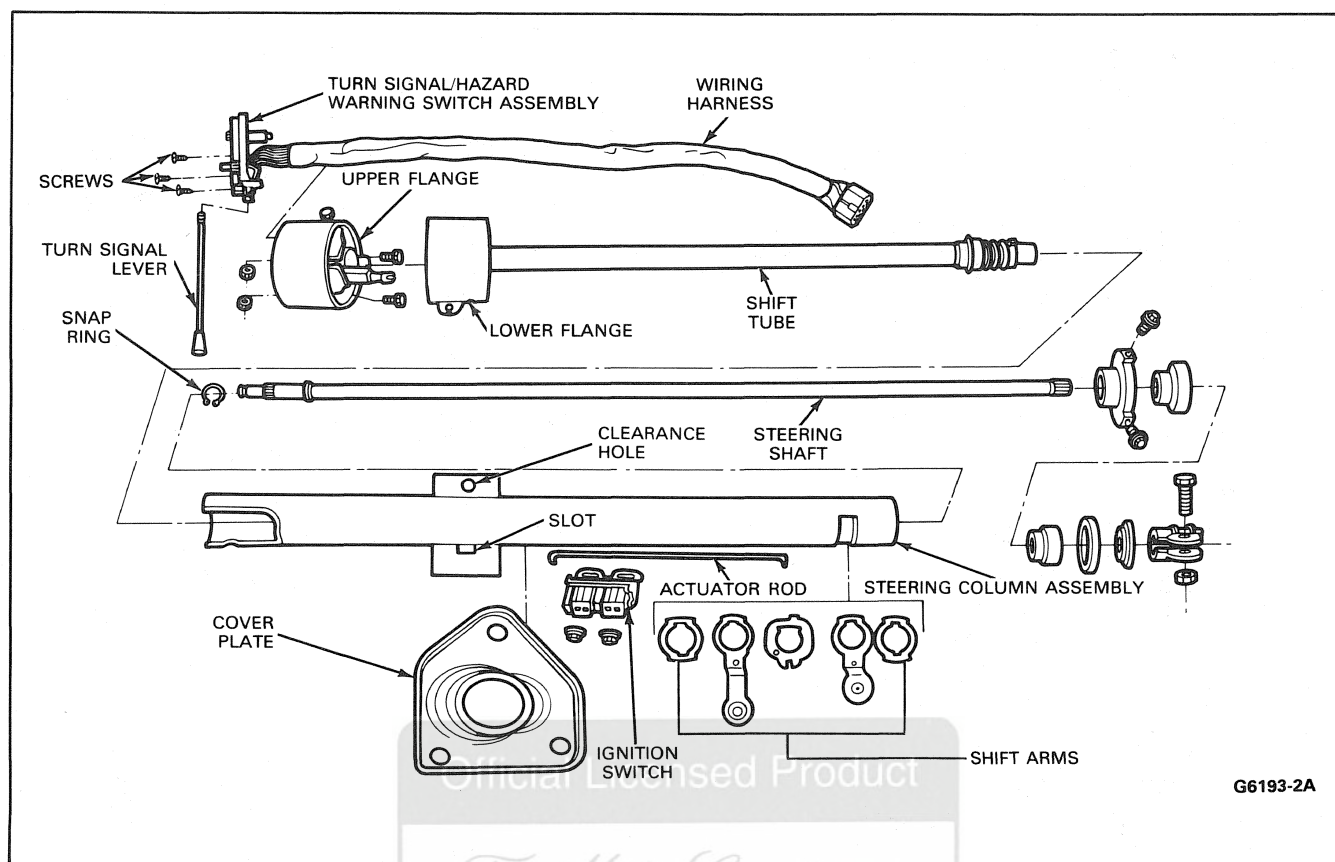
Steering Column

Disassembly

1. Remove the steering column per this Section.
2. Unscrew the turn signal lever.
3. Remove turn signal-hazard warning switch retaining screws and partially withdraw switch from upper flange.
4. Remove snap ring from steering shaft above the upper shaft bearing.
5. With a light hammer tap the steering shaft out the bottom of the steering column.
6. Clip the ignition switch in LOCK position and remove ignition switch and actuation rod.
7. Loosen the upper flange retaining nuts until 1 or 2 threads remain engaged, pinch the nuts toward each other, and pull flange off outer tube.

8. Remove shift tube retaining bolt from the bottom of the shift socket.
9. Remove the shift/socket flange extension.
10. Remove lower bearing retainer, if so equipped.
11. Withdraw shift tube from top or bottom of the steering column.
12. Withdraw lower shift arms and spacer from column outer tube.
13. Remove lamp from flange and separate turn signal-hazard warning switch from flange.
14. Remove upper shaft bearing and insulator cover from upper flange by tapping with light hammer from opposite side of flange.
15. Disassemble the upper flange and locking mechanism per this Section.
16. Remove the floor opening cover plate from the outer tube.

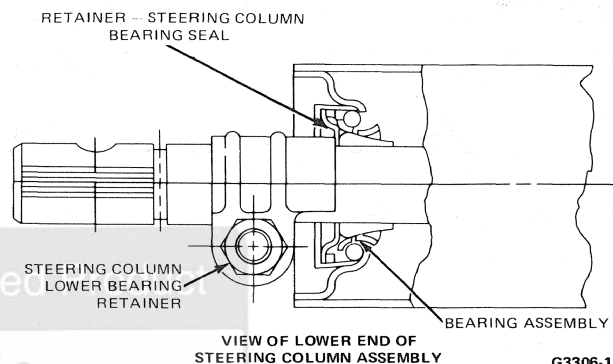
DISASSEMBLY AND ASSEMBLY (Continued)



G6193-2A

DISASSEMBLY AND ASSEMBLY (Continued)**Assembly**

1. Place bushing in socket retainer in outer tube.
2. Place bushing on upper hub and wave washer on lower hub of shift socket.
3. Insert lower shift arms and spacer in outer tube.
4. Insert shift tube assembly from top or bottom of column.
5. Install shift socket onto shift tube in outer tube or flange extension onto outer tube 1.7-2.3 N•m (15-20 in-lbs).
6. Install shift tube retaining screw in the bottom of the shift socket.
7. Place turn signal-hazard warning switch wiring harness through flange.
8. Press lamp and wire into flange.
9. Feed turn signal harness through shift socket. Pinching the flange casting subassembly retaining nuts toward each other, install flange.
10. Install ignition switch actuation rod, ignition switch and hand start the washer-nuts retaining the switch.
11. Adjust the ignition switch per this Section.
12. Install the steering shaft from the column bottom.
13. Install the lower bearing retainer.
14. Install the upper shaft bearing and insulator cover per this Section.
15. Install the snap ring on the shaft above the upper bearing.
16. Loosen the lower bearing retainer so it is free to slide on the steering shaft.
17. Seat the upper bearing by tapping on the upper end of the shaft with a rubber mallet.
18. Preload the lower bearing by sliding the bearing retainer against the bearing with the thumb and forefinger while holding the steering shaft. Tighten the retainer nut to 14-18 N•m (10-14 ft.-lb) while holding the bearing retainer.
19. Install the turn signal-hazard warning switch and tighten the 3 retaining screws.
20. Install the turn signal lever.
21. Install the steering column per this Section.



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Steering Column Flange and Locking Mechanism Subassembly

1. Install lock actuator insert in rear of flange and tighten screw 1.7-2.8 N•m (15-25 in-lbs).
2. Insert lock actuator assembly through opening in front of flange until it bottoms against insert.
3. Install lock drive gear through lock cylinder opening such that the last gear tooth aligns, with the last tooth on the actuator assembly when the actuator is fully rearward.
4. Install the lock bearing.
5. Install the snap ring.
6. With the lock cylinder in the "run" and the retaining pin depressed. Insert the lock cylinder into the flange.
7. Position spring on lock release lever assembly and position lever assembly through hole in front of flange torque spring until lever assembly is allowed to drop into place.
8. Install snap ring on lock release lever assembly.
9. Install flange retaining bolts through holes in flange and hand start nuts 1 to 2 threads on rear side.

SPECIFICATIONS

Refer to Specifications charts in Section 13-01, General Steering Service.

SPECIAL SERVICE TOOLS

Number	Description
T67L-3600-A	Steering Wheel Remover

CG3598-1A

TORQUE SPECIFICATIONS — F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS VEHICLES

Description	Torque	
	N-m	Ft-Lb
Ignition Switch Retaining Nuts	4.5-7.3	40-65
Steering Wheel Horn Cover Pad	0.8-1.2	7-11
Steering Wheel Nut	40-56	30-42
Steering Column Lower Bearing Retainer	14-18	10-14
Floor Opening Cover Plate	11-15	8-11
Intermediate Shaft Lock Bolt	27-47	20-35
	N-m	In-Lb
Lock Actuator Insert Screw	1.7-2.8	15-25
Steering Column Tube Flange Nuts	6.8-8.5	60-75
Turn Signal Switch Screws	2.5-3.0	20-30

CG6544-2A

Official Licensed Product

Ford Motor Company

SECTION 13-24 Steering Linkage

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS	13-24-1	REMOVAL AND INSTALLATION (Cont'd.)	
DESCRIPTION	13-24-1	Spindle Connecting Rod	13-24-2
REMOVAL AND INSTALLATION		Spindle Connecting Rod End	13-24-3
Drag Link	13-24-1	Steering Arm or Spindle Arm	13-24-3
Pitman Arm	13-24-2	SPECIFICATIONS	13-24-4

DESCRIPTION

The steering linkage is composed of the Pitman arm, drag link, steering connecting rod and tie rod ends. The Pitman arm transfers the steering gear movements through the drag link to the

spindle. The steering connecting rod and tie rod ends connect the spindle on the left side to the spindle on the right side.

ADJUSTMENTS

Refer to Section 13-01, General Steering Service and Section 14-01, General Suspension Service for adjustment procedures.

REMOVAL AND INSTALLATION

Drag Link

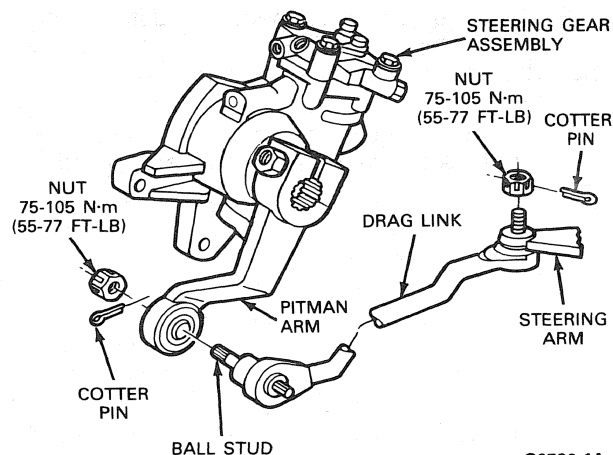
Removal

NOTE: Replace the drag link or tie rod if a ball stud is excessively loose, or if the tie rod or drag link is bent. Do not attempt to straighten a drag link or tie rod.

1. Remove the cotter pins and nuts from the ends of the drag link.
2. Using the Tie Rod End Remover TOOL-3290-D or equivalent, remove the drag link ball studs from the left hand steering arm and the Pitman arm.

Installation

1. Position the drag link to the steering arm and the Pitman arm.
2. Install the nuts and tighten to 75-105 N·m (55-77 ft-lb).
3. Install the cotter pins.



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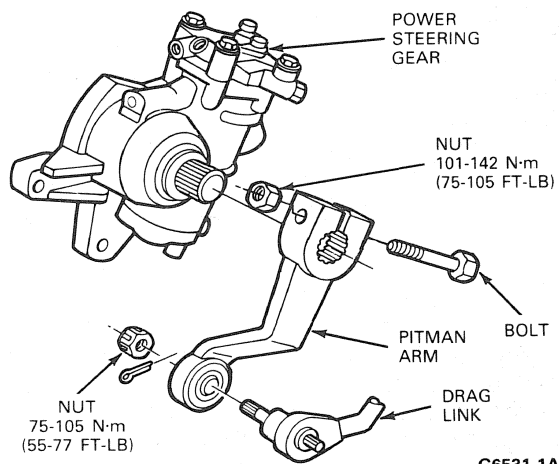
REMOVAL AND INSTALLATION (Continued)

Pitman Arm

Removal

Replace the Pitman arm if it is bent, if the ball stud hole is excessively worn, or the serrations are damaged or excessively worn. Do not attempt to straighten the Pitman arm.

1. Remove the cotter pin and nut from the drag link ball stud at the Pitman arm.
2. Disconnect the drag link ball stud from the Pitman arm using Tie Rod End Remover, TOOL-3290-D or equivalent.
3. Remove the Pitman arm attaching bolt and nut.
4. Remove the Pitman arm from the steering gear sector shaft using Tool T64P-3590-F or equivalent.



Installation

1. Install the Pitman arm to the sector shaft with the wheels in a straight ahead position. Install the Pitman arm retaining bolt and nut and tighten to 101-142 N·m (75-105 ft-lb).
2. Install the drag link ball stud on the Pitman arm. Tighten the nut to 75-105 N·m (55-77 ft-lb).

Spindle Connecting Rod

Removal

Replace the spindle connecting rod if the end threads are stripped or if the rod is damaged. **Do not attempt to straighten a bent rod.**

1. Remove the nuts and cotter pins from the ball studs on the steering connecting rod.

2. Using TOOL-3290-D, Tie Rod End Remover, disconnect the ball studs from the spindle arms.

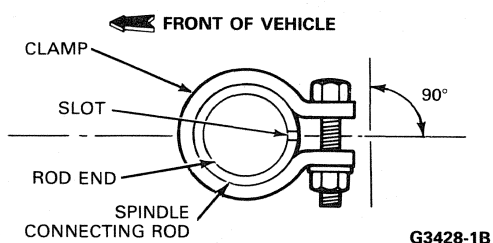
Installation

1. Position the steering connecting rod to the spindle arms and install the nuts to the ball studs. Tighten the nuts to 75-105 N·m (55-77 ft-lb).
2. Install the cotter pins.

REMOVAL AND INSTALLATION (Continued)**Spindle Connecting Rod End**

If the spindle connecting rod ball stud is excessively loose, replace the spindle connecting rod end as follows:

1. Remove the cotter pin and nut from the rod end ball stud.
2. Remove the ball stud from the spindle arm.



3. Loosen the clamp bolt, and turn the rod end out of the rod. Count the number of turns needed to remove the rod end.
4. Lubricate the threads of a new spindle connecting rod end, turn it into the rod to about the same distance the old rod end was installed. This will provide an **approximate** toe-in setting.
5. Install the ball stud in the spindle arm, tighten the nut to the specification given in this Section, and install the cotter pin.
6. Check the toe-in and adjust, if necessary. **Be sure to tighten the rod end clamps after adjusting the toe-in.** Refer to Section 14-01, General Suspension Service for the procedure.

Clamps that are not fixed should be positioned 3/16 inch from the end of the rod, with the clamp bolt at right angles to the slot in the rod. The clamp bolt must be vertical, with the head up and the clamp facing forward.

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REMOVAL AND INSTALLATION (Continued)

Steering Arm or Spindle Arm

Removal

Replace the spindle or steering arm if it is bent or damaged. Do not attempt to straighten a bent spindle or steering arm.

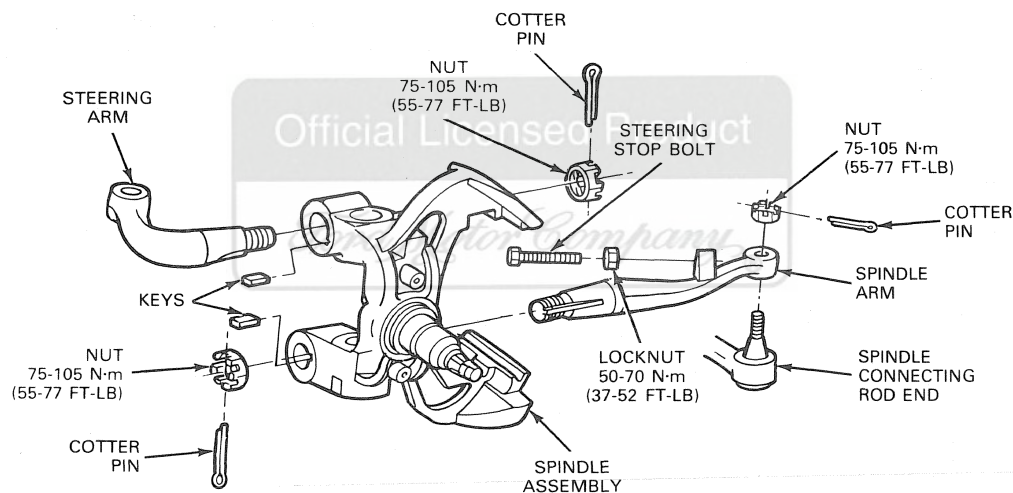
1. Remove the spindle connecting rod end ball stud or the drag link ball stud from the spindle or steering arm.
2. Remove the cotter pin and attaching nut from the arm, and remove the arm from the spindle. Drive the arm out of the spindle, if necessary.

Installation

1. Install a new arm in the spindle. The spindle hole is slotted to align the arm with a key.

Insert the key in the slot from the nut side of the spindle. Be sure that the key is flush with the slot face of the spindle.

2. Install the arm attaching nut and tighten to 75-105 N·m (55-77 ft-lb). Install a new cotter pin through the nut and spindle or steering arm.
3. Install the spindle connecting rod end ball stud or drag link ball stud in the arm, and install the ball stud nut and tighten to 75-105 N·m (55-77 ft-lb). Install a new cotter pin through the nut and ball stud.
4. Check the toe and adjust, if necessary. Refer to the procedure in Section 14-01, General Suspension Service.
5. Adjust and lock the steering stop adjusting bolts to specification as listed in Section 13-01, General Steering Service.



G6532-2A

SPECIFICATIONS

TORQUE SPECIFICATIONS F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS

Description	Torque	
	N·m	Ft-Lb
Drag Link to Steering Arm — Castellated Nut	75-105	55-77
Drag Link to Pitman Arm — Castellated Nut	75-105	55-77
Pitman Arm Retaining Bolt and Nut	101-142	75-105
Steering Connecting Rod Ends to Spindle Arms — Castellated Nut	75-105	55-77
Steering Connecting Rod End Clamp — Bolt and Nut	42-56	31-42

CG6533-1A

SPECIAL SERVICE TOOLS

Description	Number
Tie Rod Remover Tool	TOOL-3290-D
Pitman Arm Remover Tool	T64P-3590-F

CG6534-1A

SECTION 13-48 C-300N Hydraulic Power Steering Gear — Bendix

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENT		DIAGNOSIS AND TESTING	13-48-7
Adjusting the Piston to Output Shaft		DISASSEMBLY AND ASSEMBLY	
Gear Backlash	13-48-24	Housing and Side Cover	13-48-14
CLEANING AND INSPECTION		Steering Gear	13-48-10
Cleaning	13-48-17	REMOVAL AND INSTALLATION	
Inspection	13-48-17	Steering Gear	13-48-8
DESCRIPTION AND OPERATION		SPECIFICATIONS	13-48-27
Description	13-48-1		
Operation	13-48-2		

DESCRIPTION AND OPERATION

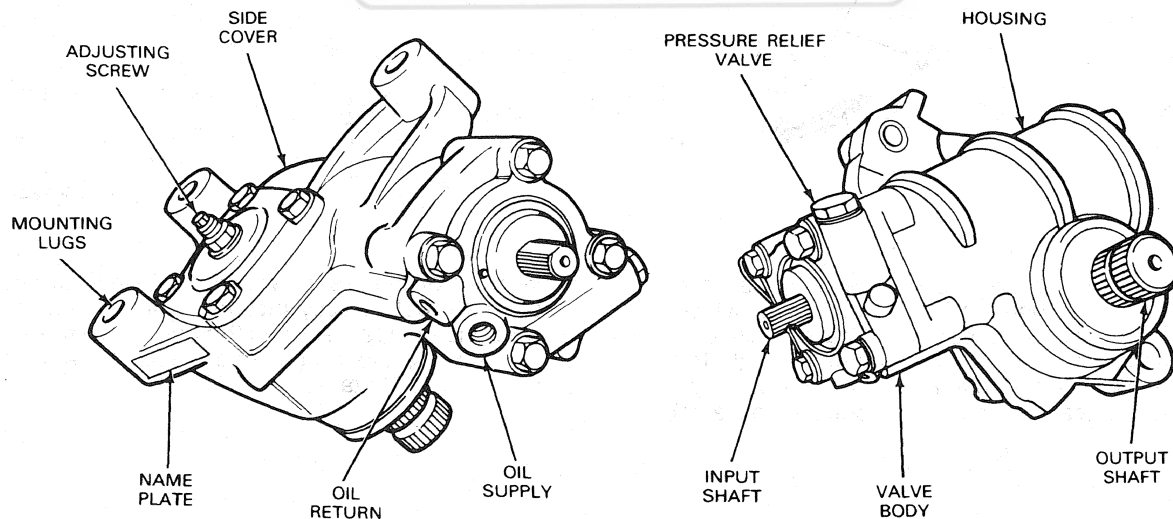
Description

The Compact 300N, or C-300N, Hydraulic Power Steering Gear is designed for medium duty vehicles with front axle weight ratings of 6,000 to 9,000 lbs.

It is an integral power steering gear incorporating the mechanical and hydraulic actuation and control components in a single cast housing which serves as the power cylinder.

The vehicle's steering column is coupled to the gear at the input shaft which transmits steering

effort through a recirculating ball screw (spindle assembly) and piston. The piston is an integral part of the power assist and also acts as a steering damper. The direction and degree of power assist is controlled by a rotary hydraulic valve which is integral to the input shaft and spindle assembly. An engine driven hydraulic pump supplies the flow and pressure.



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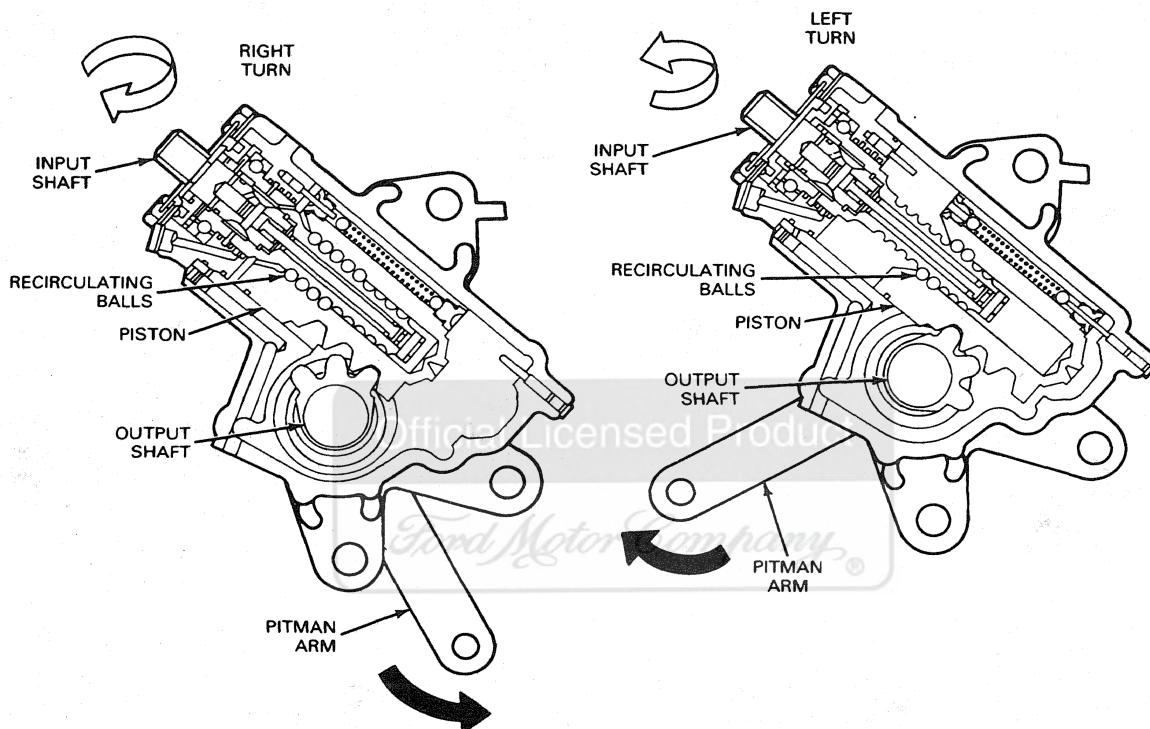
DESCRIPTION AND OPERATION (Continued)

Operation

The C-300N Integral Power Steering Gear is composed of both mechanical and hydraulic power assist components.

Actual steering is accomplished mechanically. Effort applied at the vehicle's steering wheel results in mechanical movement within the steering gear which causes the vehicle to change its direction of

travel. The hydraulic power assist components function solely to reduce the mechanical effort required to turn the vehicle's steering wheel. Loss of hydraulic power will in no way prevent the vehicle from being maneuvered mechanically, however greater effort will be required to turn the steering wheel.

MECHANICAL OPERATION

G6224-2A

The turning effort exerted by the driver on the steering wheel is transmitted to the input shaft which is part of the spindle assembly. The spindle and piston function like a screw and nut through the action of a chain of recirculating balls that serve as an interface. Rotation of the spindle causes axial

movement of the piston within the power cylinder. Gear teeth, cut directly into the piston, mesh with corresponding gear teeth on the output shaft. As the piston moves, the output shaft and the attached pitman arm are rotated.

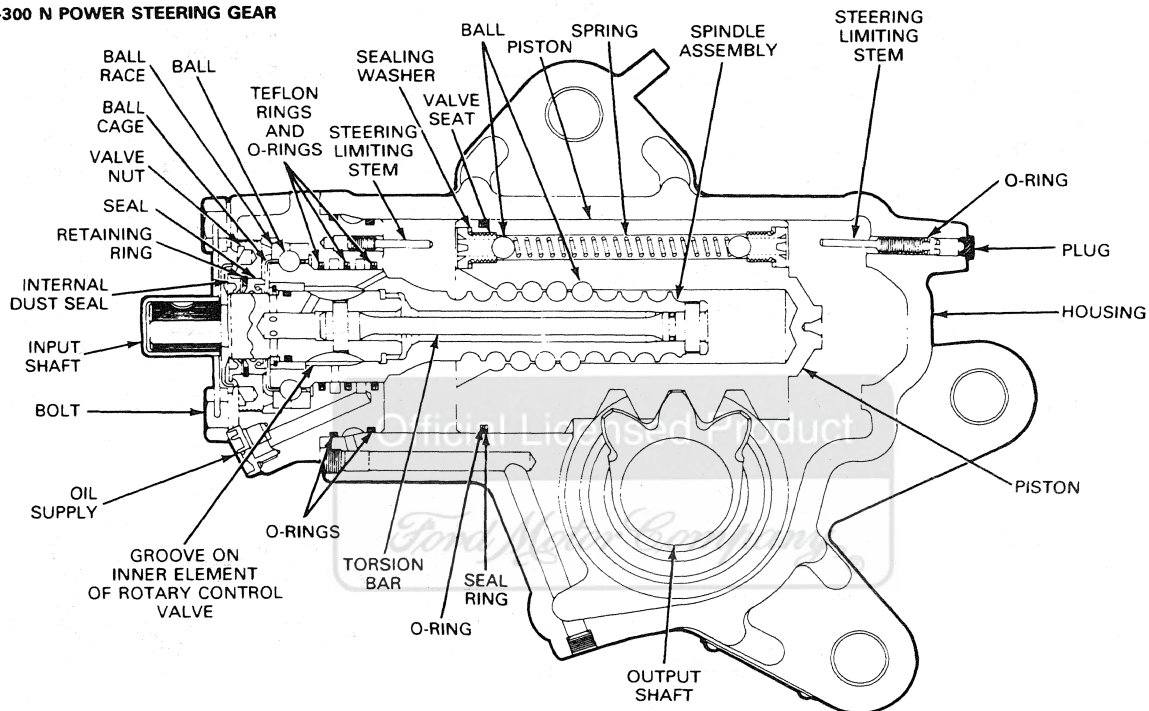
DESCRIPTION AND OPERATION (Continued)

Hydraulic Operation

Functioning together, the spindle and valve body assemblies serve as a means of flow and pressure control for the power assist portion of the steering gear. All hydraulic fluid enters and exits the power steering gear through lines connected to the threaded ports in the valve body.

The valve body assembly forms a closure for the housing and provides a means of retaining the spindle assembly. It contains a series of circular

channels and radial passages which serve to direct the flow of hydraulic oil into and out of the rotary control valve in the spindle assembly. In addition, the valve body contains a pressure relief valve. The pressure relief valve ensures that a preset maximum pressure is not exceeded. It is always set at a pressure level below that of the power steering pump relief valve and is intended to limit the power assist to a specific maximum level.

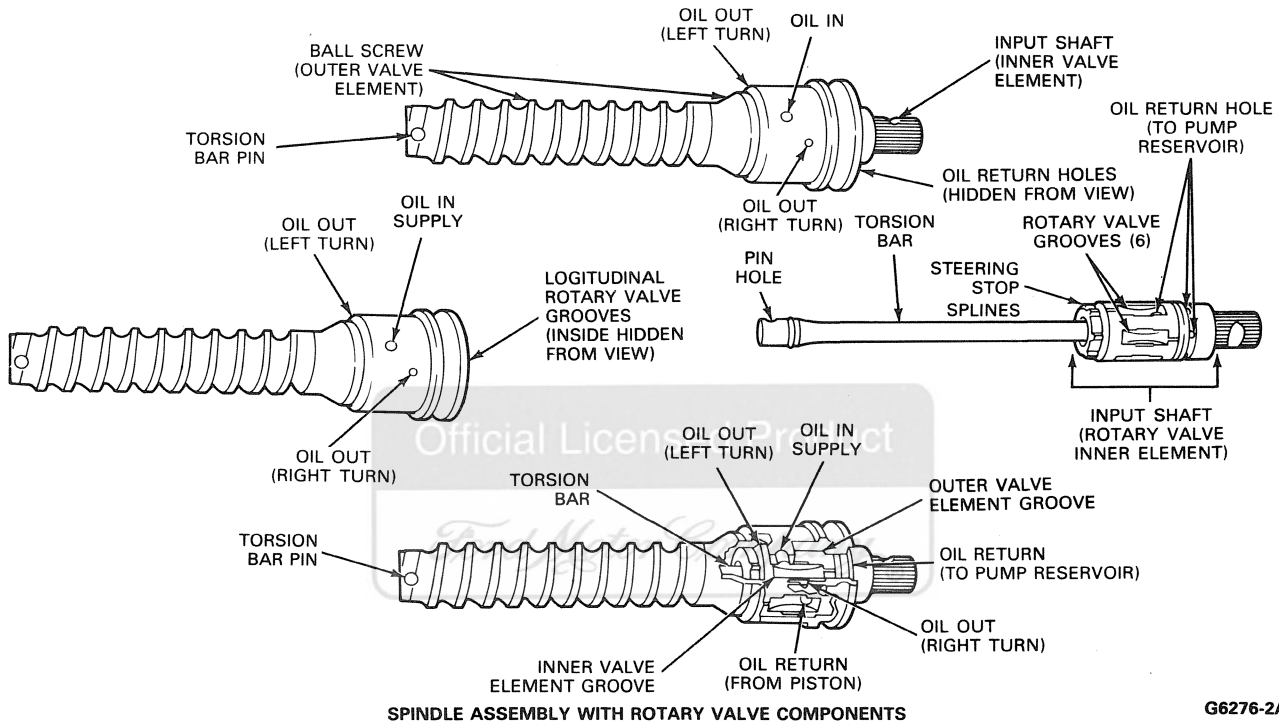
C-300 N POWER STEERING GEAR

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DESCRIPTION AND OPERATION (Continued)

The spindle assembly rotates on a ball bearing in the bore of the valve body. The spindle is composed of three major parts; the input shaft, torsion bar, and ball screw. One end of the input shaft is finely splined for connection to the steering column while the other end has a coarse spline which mates loosely with a similar spline inside the ball screw. The coarse splines form mechanical stops which limit the amount of relative rotation between the ball screw and input shaft. Six evenly distributed longitudinal grooves are machined into the outer

surface of the input shaft and correspond to six grooves machined into the bore of the ball screw. The torsion bar is pinned to the ball screw and input shaft and forms a spring connection between the two. With the input shaft inserted into the ball screw the six grooves of each of these components alternate with each other and form the hydraulic rotary control valve. Holes on the outside surface of the ball screw extend into the six grooves within its bore.



These holes allow pressurized oil to enter and exit the two parts of the rotary control valve. There are three groups of holes in the ball screw. Each group is made up of three different size holes which form a diagonal line across the surface of the ball screw. The largest hole in each group conducts pressurized

oil into the grooves of the rotary control valve. The second largest hole in each group conducts oil out of the rotary control valve to the side of the power piston furthest from the rotary control valve while the smallest hole conducts oil to the closest side of the piston.

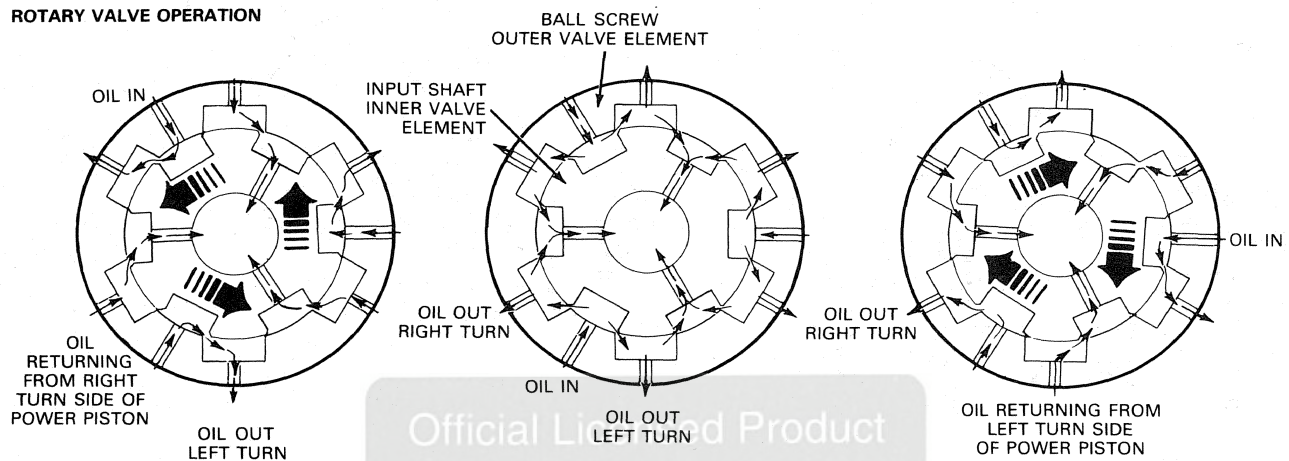
DESCRIPTION AND OPERATION (Continued)

Rotary Control Valve Operation

The rotary control valve is an open center type which allows a continuous flow of oil (through the longitudinal grooves in the input shaft and bore of the ball screw) when held in the neutral position by the torsion bar.

When steering effort is applied, the input shaft and ball screw tend to turn in unison, however the spring action of the torsion bar results in the input

shaft rotating slightly in advance of the ball screw. The six pairs of grooves that form the rotary control valve are displaced from their neutral flow position. As steering effort increases, so does the amount of displacement. Depending on the direction steered, the groove displacement of the input shaft directs hydraulic oil through the appropriate drilled passages in the ball screw to one side or the other of the piston.

ROTARY VALVE OPERATION

G6277-2B

Hydraulic pressure acting upon the piston surface eliminates much of the piston's resistance to movement. Spring force exerted by the torsion bar causes the ball screw to rotate as piston resistance is removed. As the ball screw rotates, the relative groove displacement is eliminated and the rotary valve returns to a neutral position.

Moderate effort at the steering wheel produces smaller valve displacements and lower power assist, thus providing good steering feel. At increased displacements, the pressure rises more rapidly giving increased power assistance and

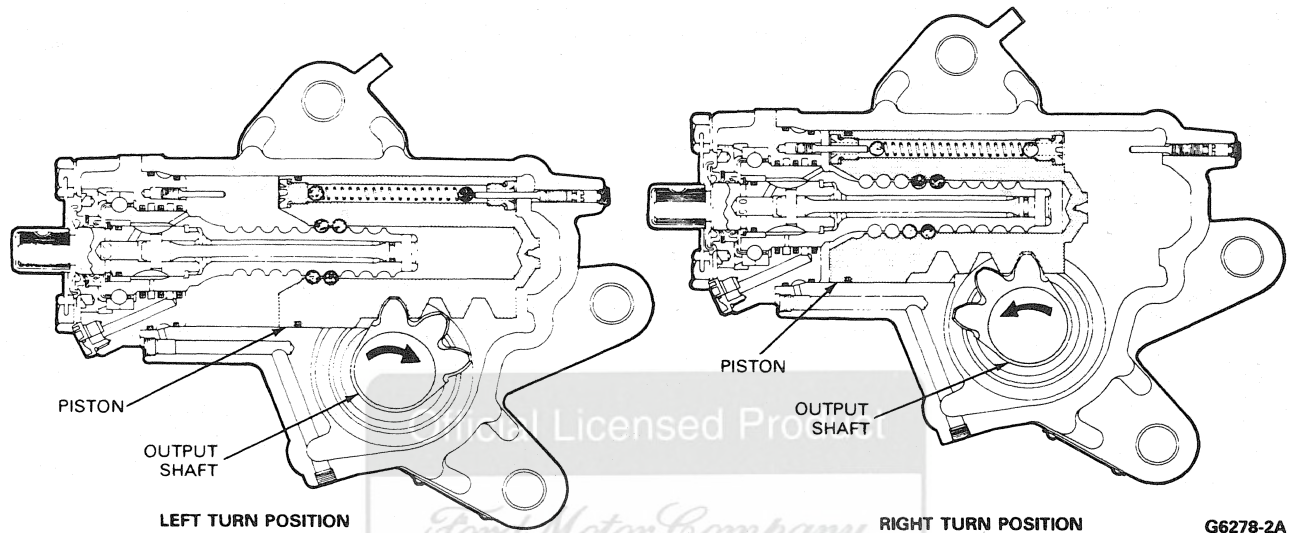
quicker response. Maximum pressure is developed after approximately $3\frac{1}{3}$ degrees displacement giving a direct feel to the steering. Groove displacement is limited by the freeplay of the stop spline mesh between the input shaft and ball screw. The splines take up the steering movement while allowing the torsion bar to hold the groove displacement. The torsion bar and stop splines form two parallel means of transmitting the steering torque. When no steering torque is applied, the torsion bar returns the valve grooves to a neutral position allowing the pressurized oil to flow to the return line.

DESCRIPTION AND OPERATION (Continued)**Steering Limiting Valve Operation**

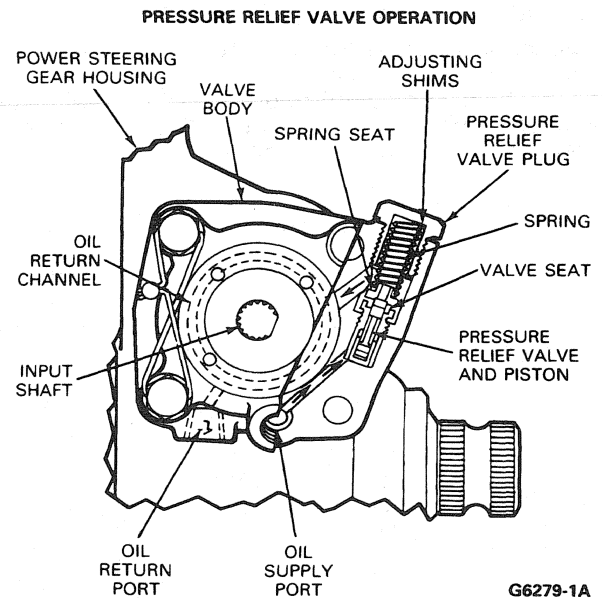
In steering gears equipped with steering limiting, power assisted movement of the piston within its bore is limited by poppet valves installed in both piston faces. As the piston approaches its extreme travel in either direction a stem unseats the steering limiting poppet valve. Some hydraulic power assist is removed as pressurized oil passes through the

poppet valve to the other side of the piston and to the return line. Continued movement of the piston will result in removal of increasing amounts of power assist and cause increased steering effort. Steering limiting reduces the maximum power assist that can be transmitted to the axle steering linkages and components.

C-300 N POWER STEERING GEAR (OPERATIONAL VIEWS)

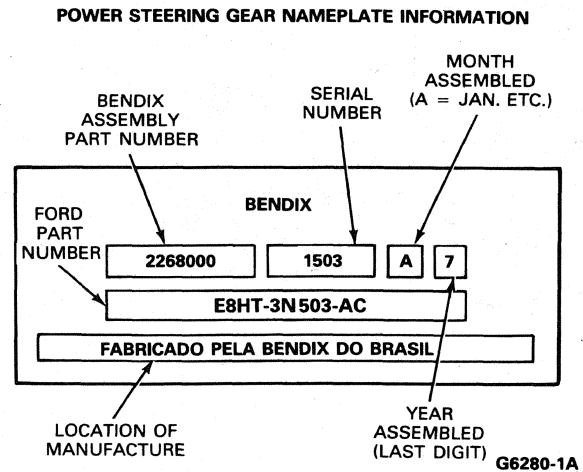
**Pressure Relief Valve Operation**

Located in the valve body the pressure relief valve limits hydraulic pressure within the power steering gear to a preset maximum. While the setting of the pressure relief valve may be adjusted to various levels depending upon part number and application, it is usually set to a pressure lower than the relief valve on the power steering pump.



DESCRIPTION AND OPERATION (Continued)**Power Steering Gear Identification**

A nameplate is attached to the exterior of the housing generally on one of the mounting lugs.

**Output Shaft Sector Teeth Adjustment**

The gear lash between the piston teeth and sector gear should not require attention in normal service, however a provision for adjustment is provided.

Adjustment requires that the steering gear be drained and the pitman arm and input shaft be disconnected from the vehicle. The adjustment procedure is described at the end of the assembly section of this manual.

Output Shaft Boot and Dust Seal

Inspect the integrity of the output shaft boot and dust seal. These components prevent contamination from entering the housing around the output shaft. If deterioration is noted, these components should be replaced.

DIAGNOSIS AND TESTING

Refer to Section 13-01, General Steering Service.

REMOVAL AND INSTALLATION (Continued)

Removal

1. Disconnect the power steering pressure line at the gear.
2. Disconnect the power steering return line at the gear.
3. Remove the bolt and nut holding the Pitman arm to the sector shaft. Remove the Pitman arm from the sector shaft using steering Pitman arm remover Tool T64P-3590-F, or equivalent.
4. Remove the bolt and nut holding the U-joint to the steering gear input shaft.
5. Remove the bolts and nuts holding the steering gear to the frame side rail. Remove the steering gear.

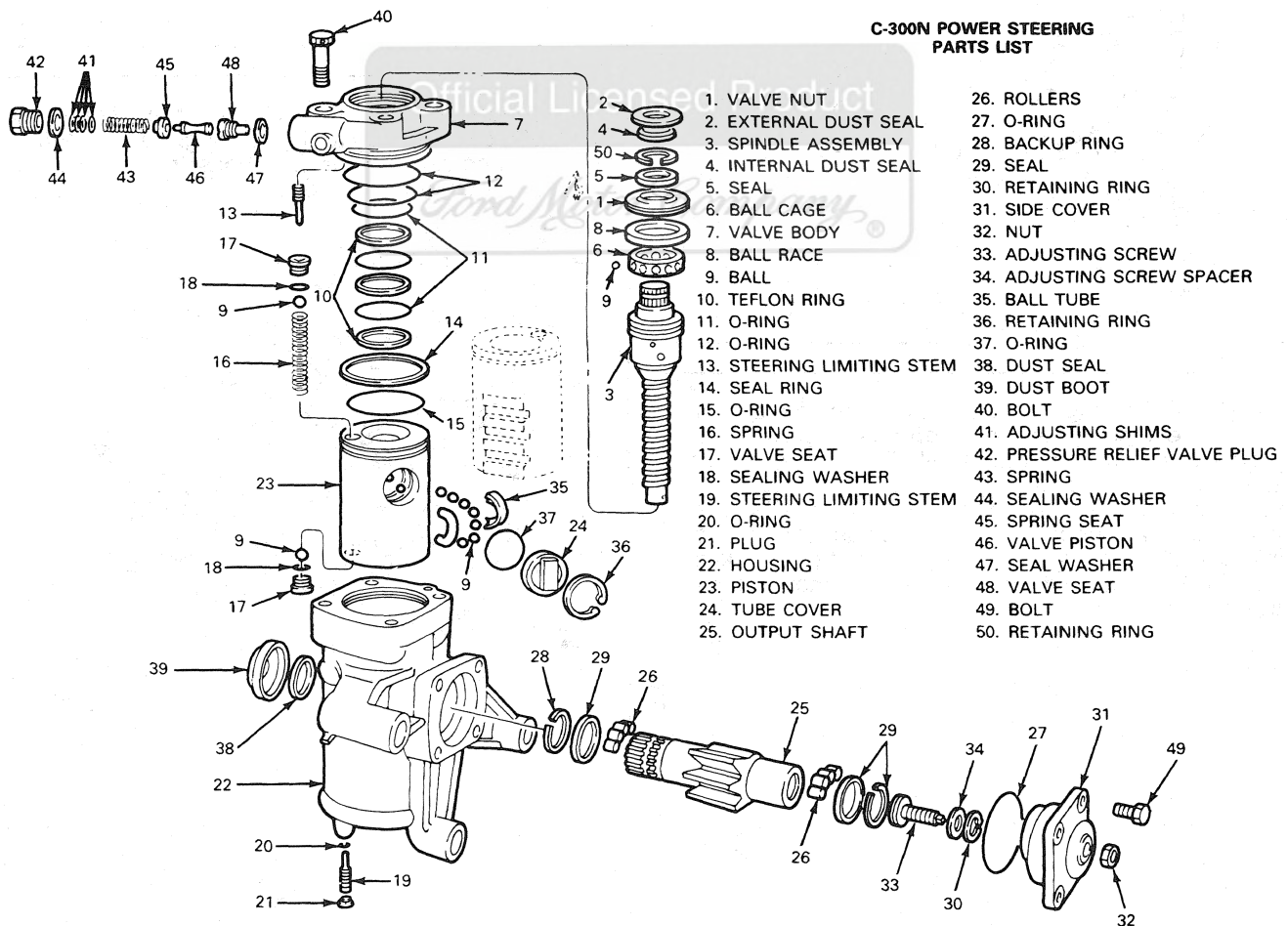
Installation

1. Place the gear on the side rail. Install the bolts and nuts and tighten to 203-278 N·m (150-205 ft-lbs.).
2. Place the intermediate shaft U-joint on the steering gear input shaft. Tighten to 68-95 N·m (50-70 ft-lbs.).

3. Place the Pitman arm on the steering gear sector shaft, making sure the timing mark on the Pitman arm aligns with the timing mark on the sector shaft. Use a chisel to help spread the Pitman arm to slide onto the sector shaft.

WARNING: DO NOT USE A HAMMER TO FORCE THE PITMAN ARM ONTO THE SECTOR SHAFT. THIS MAY LEAD TO DAMAGE OF THE SECTOR SHAFT BEARINGS AND A LOSS OF GEAR PRELOAD.

4. Install the bolt and nut. Tighten the nut to 299-406 N·m (220-300 ft-lbs.).
5. Connect the power steering pressure and return lines to the gear.
6. Fill the reservoir with fluid specified at the end of this Section.
7. Start the engine, turn the steering wheel from left to right, and check for fluid leaks.



DISASSEMBLY AND ASSEMBLY

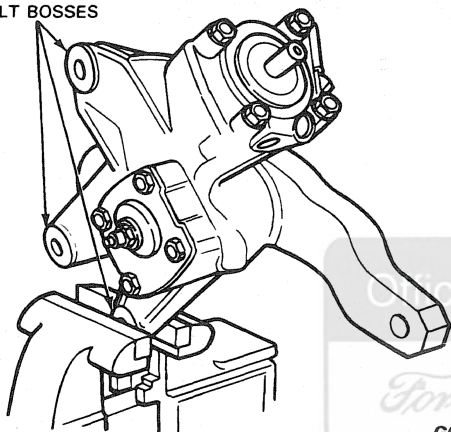
Steering Gear

Disassembly

A high level of cleanliness should be observed at all times when working on the power steering gear. Clean the exterior of all parts prior to disassembly.

After removing the power steering unit from the vehicle and cleaning the outside, secure the power steering unit to the work bench for disassembly. A large vise with jaw protectors may be used. Clamp across the mounting bolt bosses. (Do not overtighten.)

HOUSING
MOUNTING
BOLT BOSSES



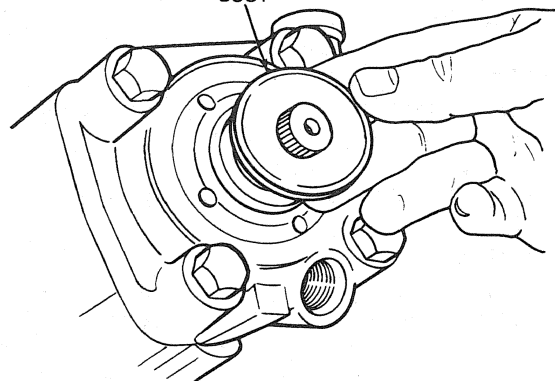
G6283-1A

NOTE: Following disassembly and assembly procedure is presented for reference purposes and presupposes that a major rebuild of the power steering gear is being undertaken. Several replacement parts and maintenance kits are available which do not require full disassembly. The instructions provided with these parts and kits should be followed in lieu of the instructions presented here.

Output Shaft

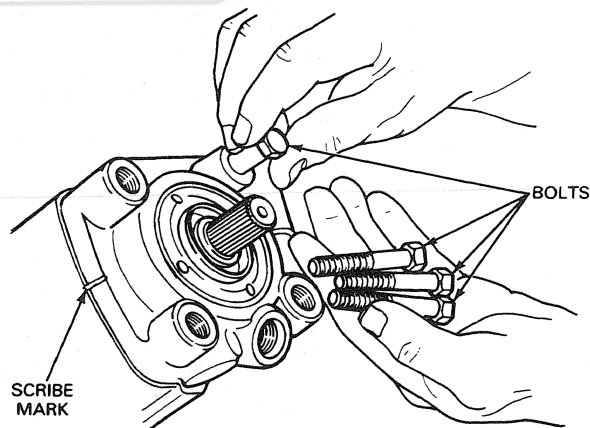
1. Remove the external dust boot from the spindle assembly's input shaft spline.

DUST
BOOT



G6284-1A

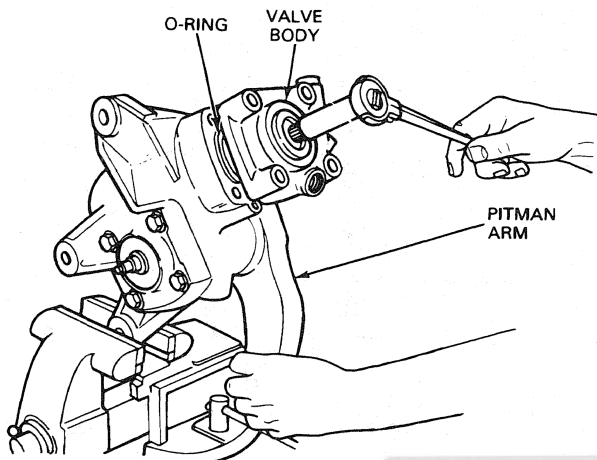
2. Scribe a line or otherwise mark the relationship of the valve body to the housing. Using a 19mm wrench remove the four bolts that secure the valve body to the housing.



G6285-1A

DISASSEMBLY AND ASSEMBLY (Continued)

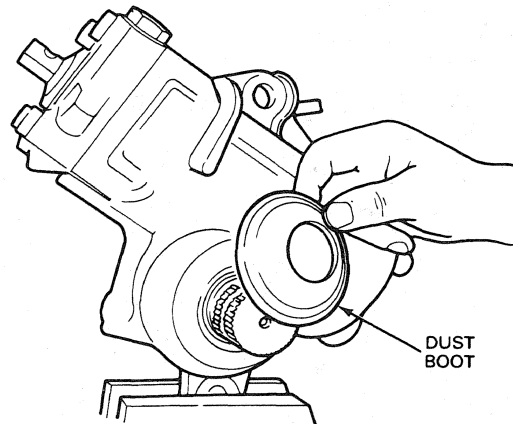
3. Separate the valve body from the housing by rotating the output shaft using the pitman arm. It may be necessary to hold or rotate the input shaft during this operation. Continue to separate the valve body from the housing until both O-rings on the valve body can be seen.



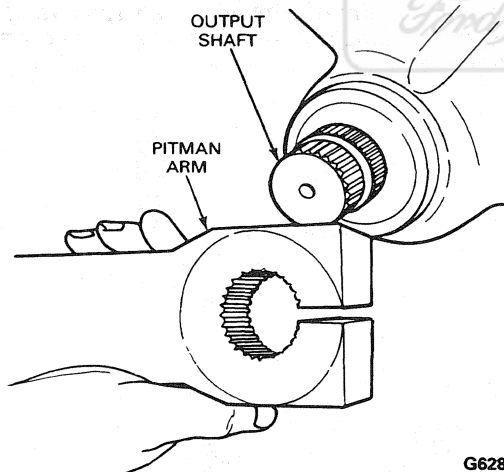
G6286-1A

4. Remove the dust boot.

Remove any accumulated dirt, grease, grime, and corrosion from the exposed portion of the output shaft to facilitate removal through its seals.

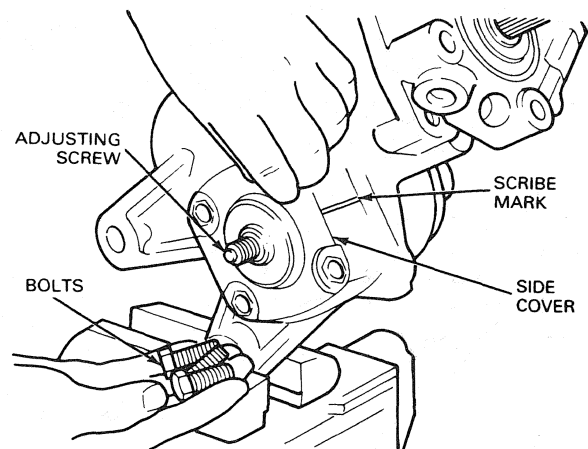


G6288-1A



G6287-1A

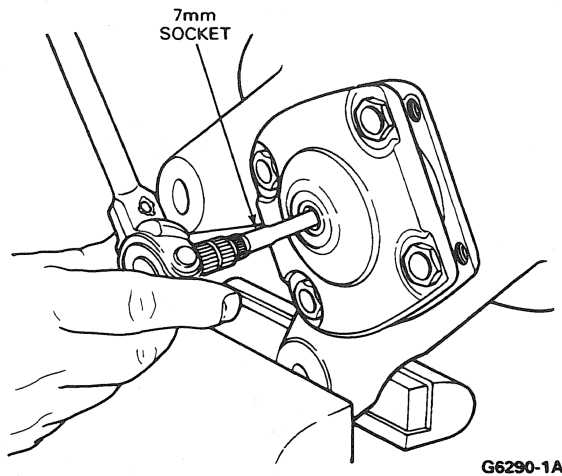
5. Loosen and remove the lock nut from adjusting screw on the side cover using a 19mm wrench.
6. Scribe a line or otherwise mark the relationship of the side cover to housing. Using a 19mm wrench, remove the four bolts that secure the side cover to the housing.



G6289-1A

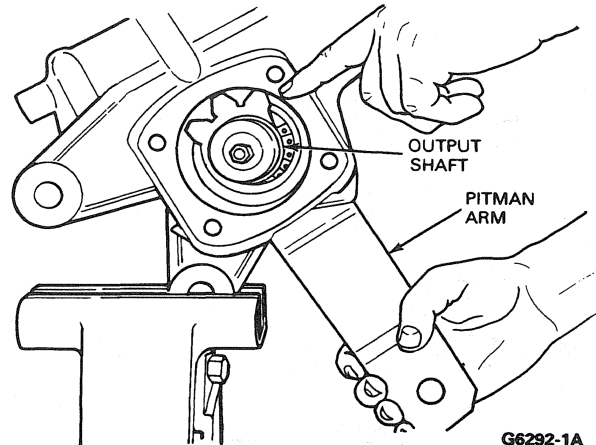
DISASSEMBLY AND ASSEMBLY (Continued)

7. Separate the side cover from the housing by turning the adjusting screw clockwise with a 7mm socket. Continue turning the adjusting screw until the side cover can be removed from the housing.

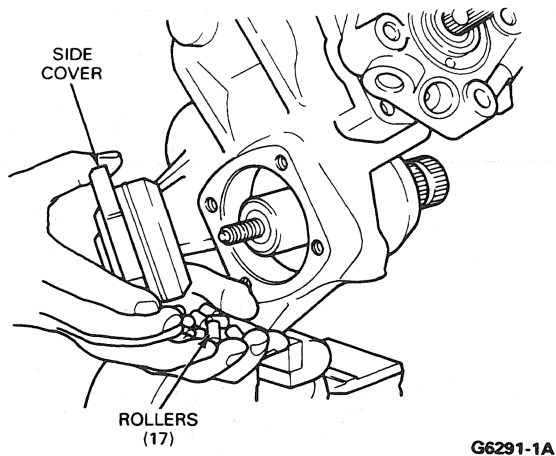


CAUTION: Do not attempt to remove the outer race of the roller bearing from the side cover.

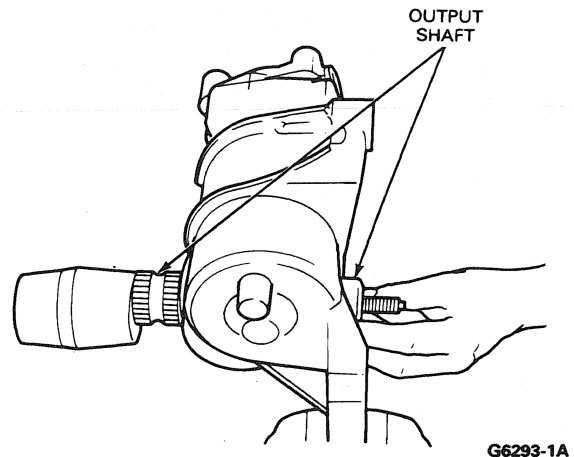
8. Loosely install the pitman arm and use it to center the piston and output shaft gear teeth inside the side cover opening of the housing.



When the side cover is removed from the housing the 17 rollers in the side cover bearing will fall out loose. These rollers **MUST NOT BE INTERCHANGED** with the rollers in the housing bearing which is identical.



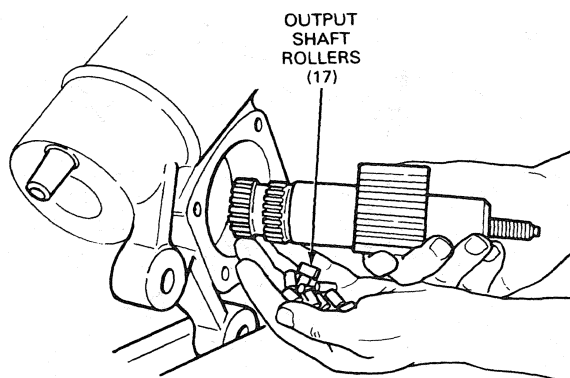
Remove the pitman arm and then remove the output shaft by tapping gently on the splined end with a soft mallet.



DISASSEMBLY AND ASSEMBLY (Continued)

When the output shaft is removed from the housing, the 17 rollers in the housing bearing will fall out loose. These rollers **MUST NOT BE INTERCHANGED** with the rollers in the side cover bearing which is identical.

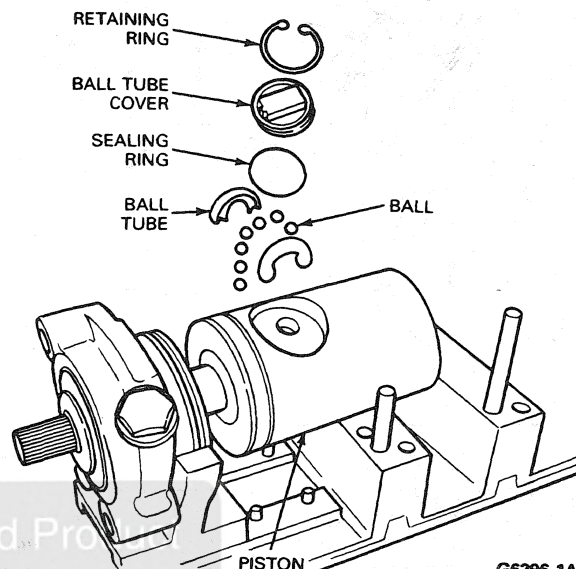
CAUTION: Do not attempt to remove the outer race of the roller bearing from the housing.



G6294-1A

10. Remove the retaining ring ball tube cover the ball tube and 7 of the 26 balls from the piston. Remove the sealing ring from the piston.

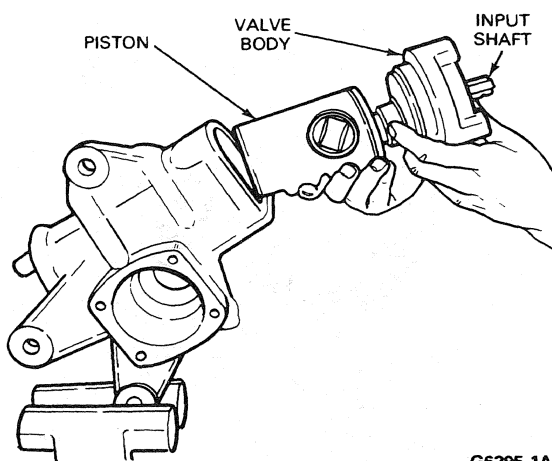
NOTE: Holding fixture (Bendix Tool 297678) which is pictured is a convenience but not a necessity for disassembly.



G6296-1A

Piston

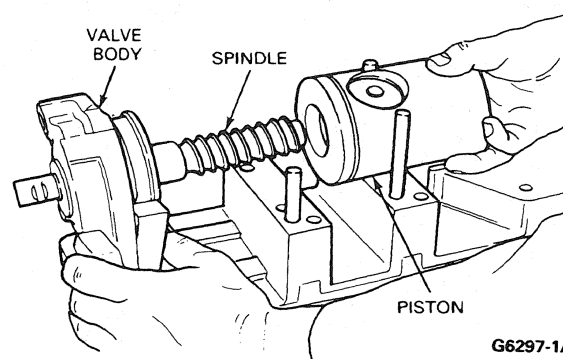
9. While preventing rotation of the input shaft end of the spindle assembly, pull the valve body and piston out of the housing.



G6295-1A

11. In order to remove the remaining 19 balls from piston, rotate the input shaft in the direction (clockwise or counterclockwise) that threads the spindle assembly **OUT OF THE PISTON**.

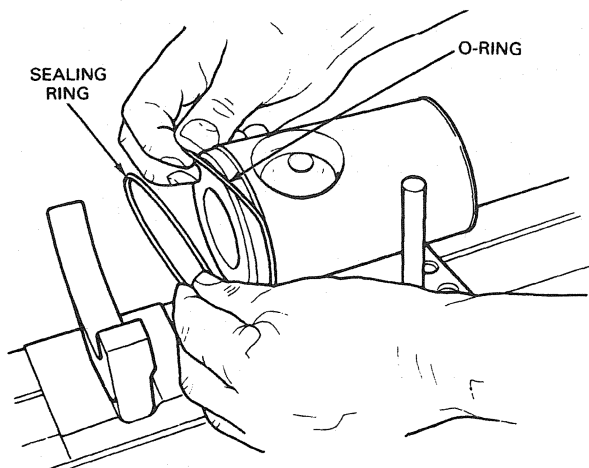
Separate the valve body and spindle from the piston. Check the inside of the piston for any stray balls that may not have been removed in the operation above. A total of 26 balls, 7 from the ball tube and 19 from the piston, should be accounted for.



G6297-1A

DISASSEMBLY AND ASSEMBLY (Continued)

12. Remove the sealing ring and O-ring below it from the groove in the piston.

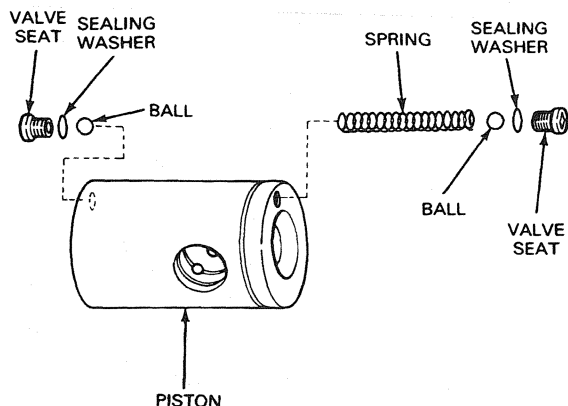


G6298-1A

13. Remove either of the steering limiting valve seats and sealing washer from the piston. Either a Phillips or straight blade screwdriver will be required, depending upon which of the two styles of body is in use.

NOTE: Care must be taken during this operation since damage to the screwdriver slot will make removal difficult.

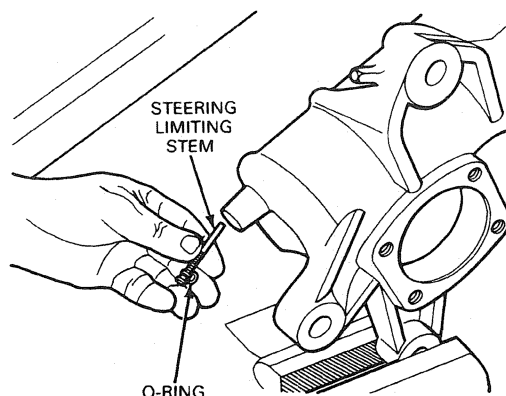
14. Remove one of the two balls the spring then the remaining ball. Referring to the previous step, remove the remaining steering limiting valve seat and its sealing washer from the other end of the piston.



G6299-1A

Housing and Side Cover

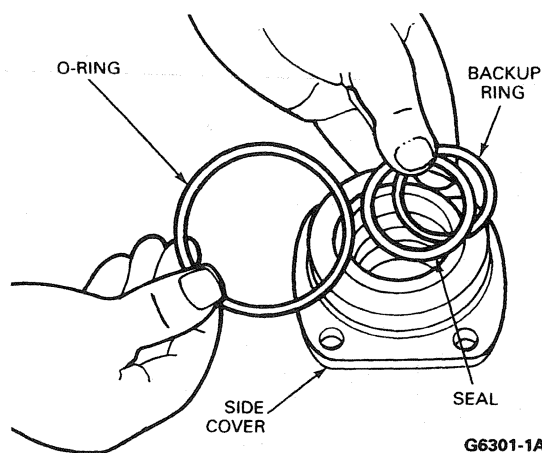
15. Remove the steering limiting stem protective plug from the housing. Using a screwdriver remove the stroke limiting valve stem from the housing and separate the O-ring from the stem.



G6300-1A

16. Remove the O-ring from the side cover. Remove the seal and its split nylon backup ring from the side cover bore. The nylon split ring comes out separately but is part of the seal.

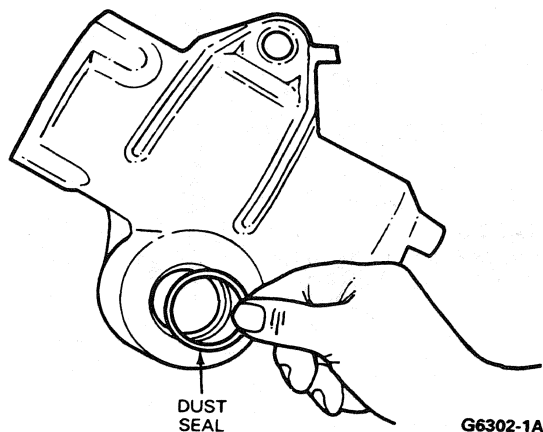
Caution: Do not remove the outer race of the roller bearing from the side cover.



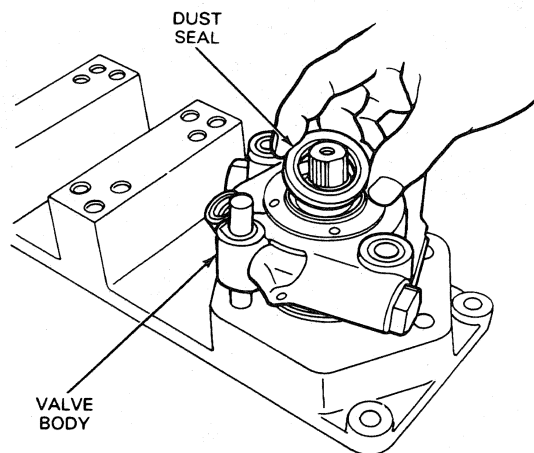
G6301-1A

DISASSEMBLY AND ASSEMBLY (Continued)

17. Carefully pry out and remove the dust seal from the housing.

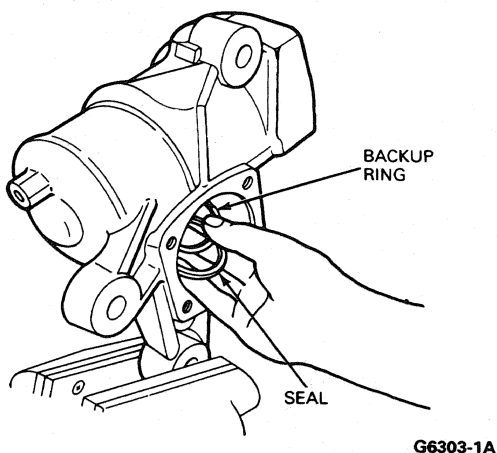
**Valve Body and Spindle**

19. Remove the input shaft dust seal from the valve nut.

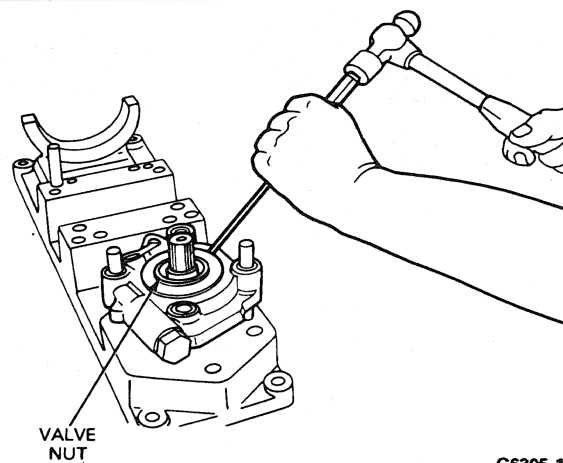


18. Reaching through the side cover opening of the housing remove the output shaft seal and its split nylon backup ring which comes out separately but is part of the seal.

Caution: Do not remove the outer race of the roller bearing from the housing.

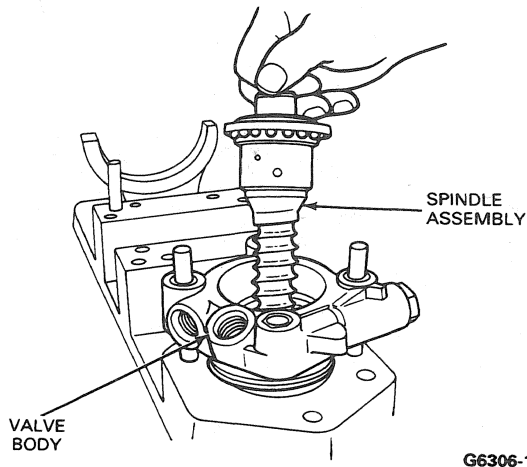


20. With a drift punch, unblock the safety point between the valve nut and valve body. Using Spanner wrench Bendix Tool 106234, or equivalent loosen and remove the valve nut from the valve body.

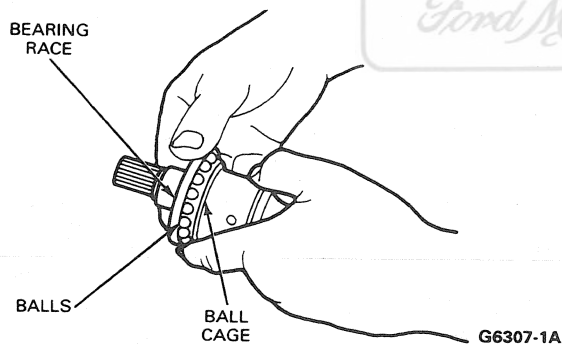


DISASSEMBLY AND ASSEMBLY (Continued)

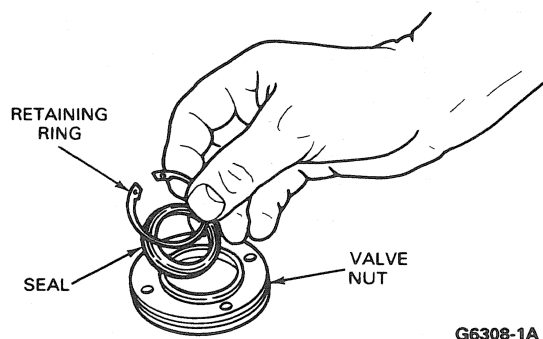
21. Grasp the input shaft end of the spindle assembly and lift the spindle assembly, ball cage, 17 balls and one half of the outer race out of the valve body.



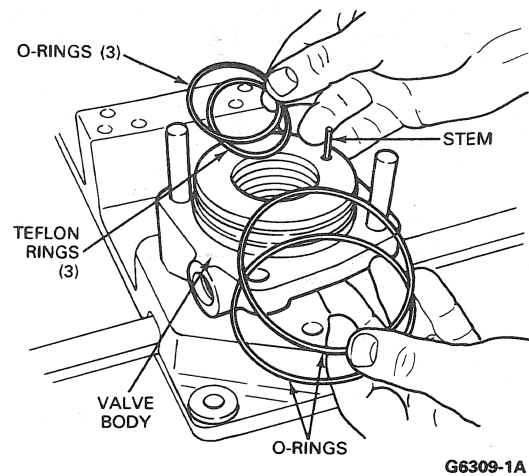
22. Separate the outer race, ball cage and 17 balls from the spindle assembly.
23. Do not remove the other half of the ball bearing outer race in the valve body.



24. Remove the retaining ring and then the seal from the valve nut.



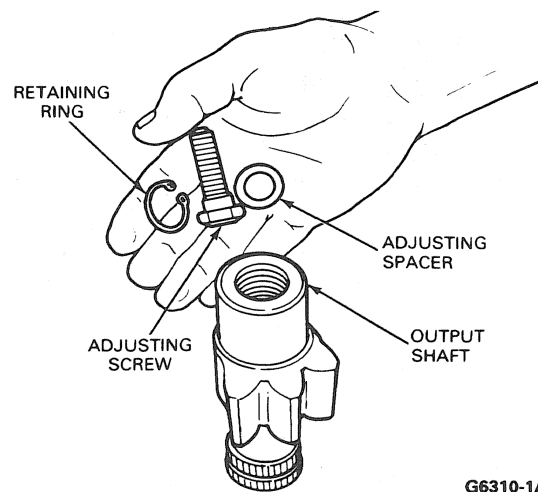
25. Remove the two outside O-rings from the valve body then remove the three Teflon rings and the corresponding three O-rings from the spindle bore.



26. If the steering gear is equipped with a steering limiting feature check the condition and length of the limiting stem in the valve body. The length of the stem measured from the surface of the valve body to the tip of the stem should be specified in the vehicle service manual. If the limiting stem is of the correct length and in good condition, **DO NOT REMOVE** it. The limiting stem can be removed if necessary by heating the poppet stem to loosen the lockite, and then turning counterclockwise.

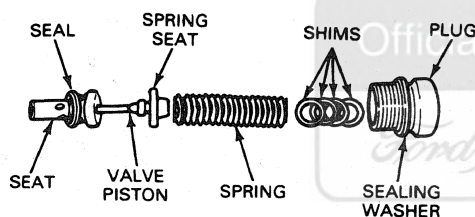
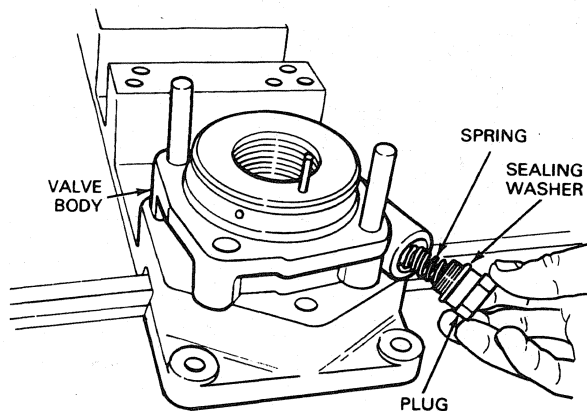
Output Shaft

27. Remove the retaining ring, the adjusting screw spacer and the adjusting screw from the output shaft.



DISASSEMBLY AND ASSEMBLY (Continued)**Pressure Relief and Valve**

28. Begin disassembly of the pressure relief valve by removing the plug and its sealing washer from the valve body.
29. Remove the spring, spring seat adjusting shims and the valve piston.



G6311-1A

30. Using a wide bladed screwdriver or Bendix Tool 298080, remove the valve seat and its sealing washer.

Spindle

Caution: Do not attempt disassembly of the spindle assembly which contains the rotary valve. Individual replacement parts are NOT available. It must be treated as a single component.

CLEANING AND INSPECTION**Cleaning**

Wash all parts individually in clean solvent and dry thoroughly. All non-metallic parts should be discarded and replaced with new.

Inspection

Parts found broken, cracked, distorted, excessively pitted, or scored must be replaced. Cause for the replacement of any part should be investigated and corrected to prevent reoccurrence.

Visually inspect all parts carefully paying particular attention to:

1. Bearings and bearing surfaces should not exhibit brinelling, pitting, spalling or cracks. If upon inspection, it is determined that the outer races of the roller bearings contained in the housing or the side cover are not serviceable, the entire housing or side cover must be replaced. If the outer ball bearing race remaining in the valve body is not serviceable, the entire valve body must be replaced. Inspect the bearing surfaces of both the inputs.
 2. Gear teeth in the output shaft and piston may show signs of polishing and slight wear, however, pitting, spalling, and cracks should not be present.
 3. Output and input shaft splines.
 4. Check the ball rolling surfaces on the exterior of spindle and interior of piston for cracks, pitting, spalling and brinelling.
 5. Exterior of piston and interior of housing bore.
- Note: Minor scuffing of the piston exterior and housing bore can be considered normal. If deep scoring is detected, the affected parts should be replaced as leakage will occur and steering control and reaction will be affected. Do not attempt honing or boring of these parts as leakage rates will increase.
6. Pitman arm.
 7. Exterior of housing and its mounting lugs.
 8. Valve body and porting.

CLEANING AND INSPECTION (Continued)

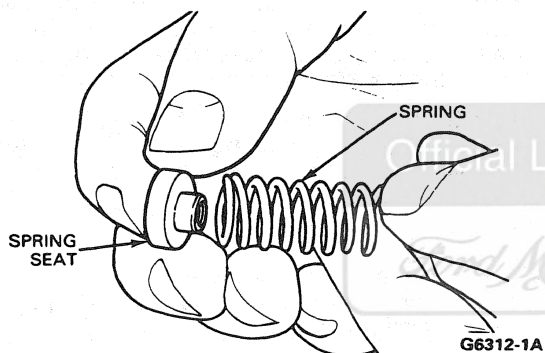
Assembly

To ensure proper operation of the power steering gear, the following procedure and its sequence should be carefully followed. Failure to do so may result in damage to the gear or faulty operation or both.

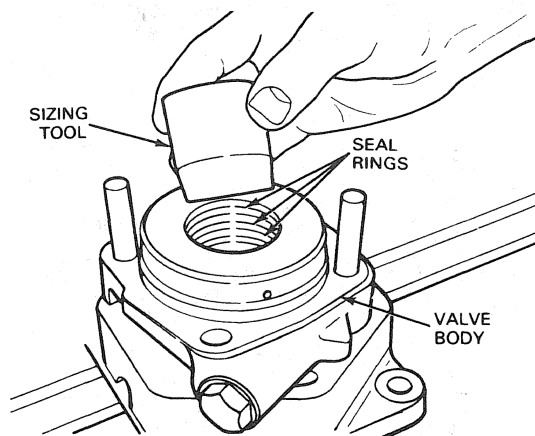
The appropriate maintenance kits should be obtained prior to reassembly.

1. Install the sealing washer around the pressure relief valve seat and using a large bladed screwdriver, or Bendix Tool 298080 install both in the valve body. Tighten the valve seat to between 20-24 N·m (15-18 ft-lbs.).
2. Install the pressure relief valve piston spring seat and spring in the valve body.

Caution: The spring seat must be installed as shown in illustration. Incorrect installation of the spring seat will result in malfunction of the relief valve and damage to the valve and seat.



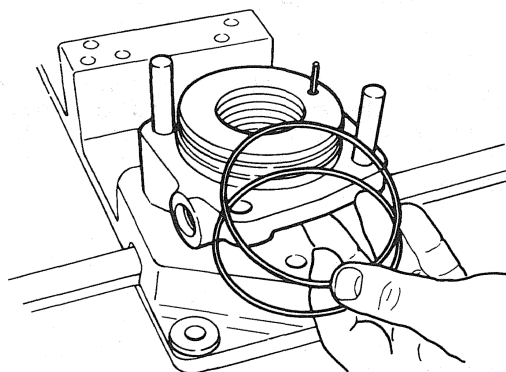
NOTE: Prelubricate the tool with a light film of lithium base grease. The spindle assembly can be used to assist in pushing the tool through the bore.



5. If the steering limiting valve was removed from the valve body, install the stem now. Apply Loctite 222 to the threads and screw the limiting stem into the valve body until a stem height of 22.2mm (0.874 inch) above the valve body surface is obtained.

IMPORTANT: Use care in applying the Loctite compound to prevent this material from coming in contact with other surfaces of the valve body. Allow sufficient time to cure.

6. Install the O-rings on the valve body.



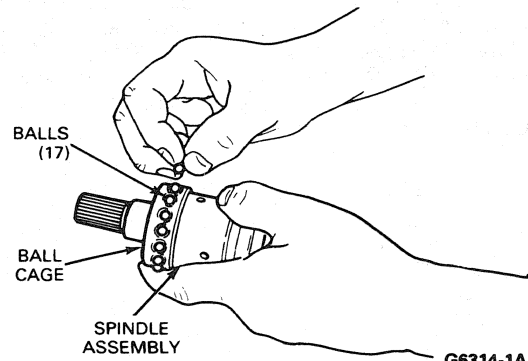
3. Install the pressure adjusting shims and the seal washer on the plug. Install the plug in the valve body and torque to 89-99 N·m (66-73 ft-lbs) using a 26mm socket.

NOTE: When installing the pressure adjusting shims use the shims that were removed during disassembly. However, if a complete rebuild of the power steering gear is underway, it may be necessary to add or subtract shims in order to properly set the pressure relief valve.

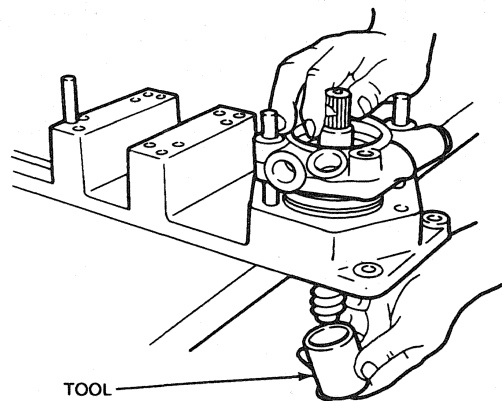
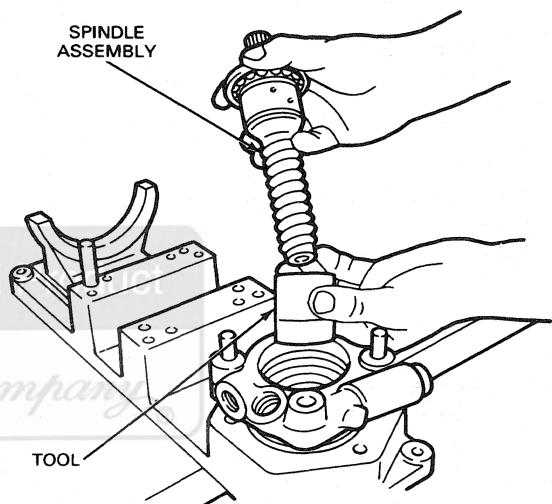
4. Install the three O-rings and three Teflon® rings in the appropriate grooves in the valve body. Form (expand) the Teflon® rings into their grooves by 'pushing' Bendix Tool 297676, or equivalent through the bore of the valve body.

CLEANING AND INSPECTION (Continued)

7. Install the ball cage on the input end of the spindle assembly. Using Ford Long Life Lubricant C1AZ-19590-BA, or equivalent grease to hold them in place, install the seventeen balls in the ball cage.



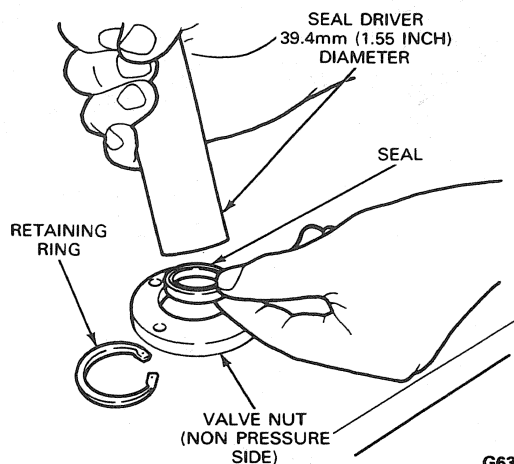
8. Install the outer ball bearing race half over the input end of the spindle assembly and insert the spindle assembly through the ring seating tool (Bendix Tool 297676, or equivalent). Insert the spindle and tool into the valve body until tool completely exits the other side and the seventeen balls of the bearing assembly are resting against the outer race in the valve body.



G6315-1A

CLEANING AND INSPECTION (Continued)

9. Position the pressure side of the seal in the bore of the non-pressure side of the valve nut. Carefully drive the seal into the bore until the snap ring groove within the bore is visible. Install the retaining ring making certain it is completely seated in the groove.



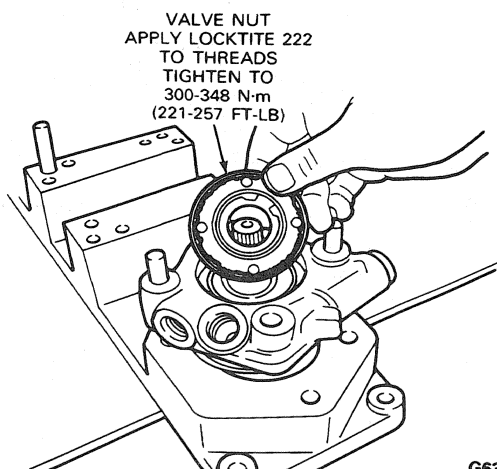
G6316-1A

After installing the retaining ring, gently tap the seal from the opposite side until it rests squarely against the snap ring.

NOTE: The seal can be driven into the valve body bore using a piece of round brass stock with a diameter of 39.4mm (1.55 inch).

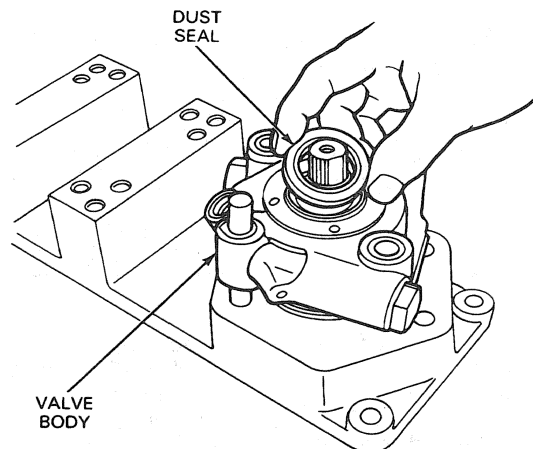
10. Apply Loctite 222 to the thread of the valve nut. NOTE: Due to the proximity of the spindle ball bearing, use extreme care in applying the Loctite 222 to the valve nut threads. Making certain not to damage the seal install the valve nut over the input shaft end of the spindle assembly and into the valve body using a suitable spanner wrench such as Bendix Tool 10623 torque the valve nut to 300-348 N·m (221-257 ft-lbs).

Reset the safety point between the valve nut and valve body using a drift punch or similarly appropriate tool.



G6317-1A

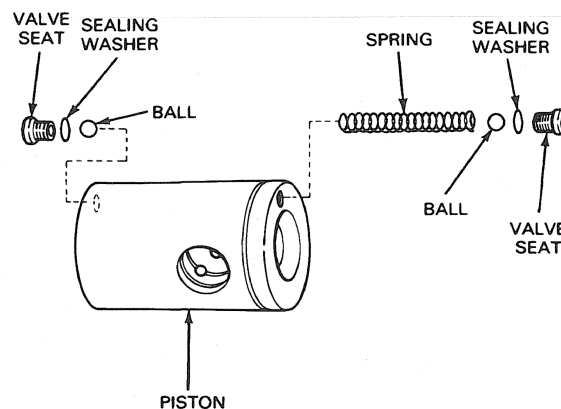
11. Install the dust seal in the valve nut taking care not to damage the seal.



G6304-1A

Piston

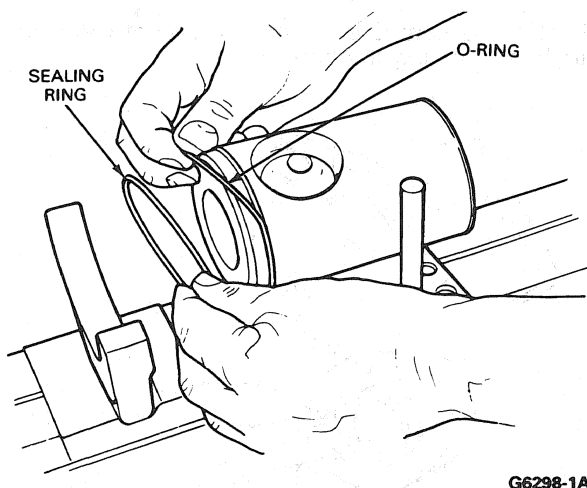
12. Install one of the two steering limiting valve seats and its sealing washer into the piston. Insert one of the two balls then the valve spring into the piston from the opposite end and install the remaining ball, sealing washer, and seat in the piston. Taking care not to damage the valve seats, torque each to 10-15 N·m (88-132 in-lbs).



G6299-1A

CLEANING AND INSPECTION (Continued)

13. Install the O-ring into its groove in the piston.

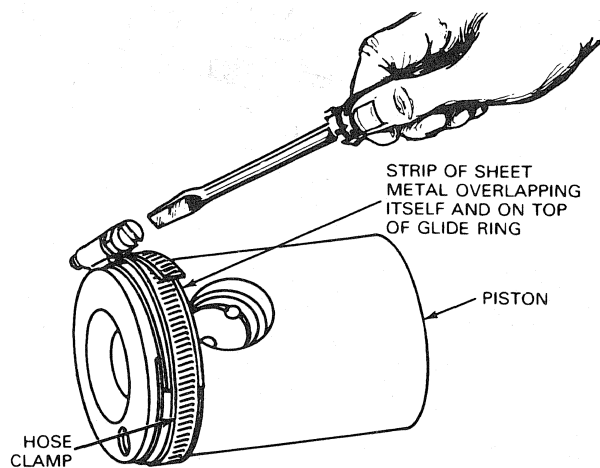


14. Thoroughly heat the glide ring to 140°-160°C (285°-320°F) in preparation for installation on the piston.

NOTE: DO NOT USE AN OPEN FLAME to heat the glide ring. A heat lamp or a similar device should be used.

15. Install the heated glide ring over the O-ring in the piston's groove.

IMPORTANT: The glide ring should be distorted as little as possible during installation. Using an automotive piston ring compression tool or a smooth piece of sheet metal and an appropriately large screw type hose clamp, reshape the glide ring into the piston groove. Allow approximately ten minutes cooling time before removing the compression tool from the piston.



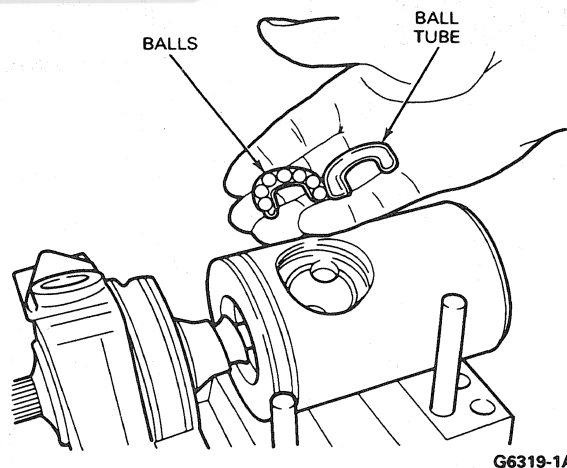
16. Install the O-ring in its groove in the ball return opening of the piston.

17. Insert the valve body and spindle assembly all the way into the piston making certain that the stroke limiting stem is not damaged and that it mates with the valve seat in the piston. Insert nineteen of the balls, one at a time, into one of the recirculating tube holes in the ball return opening in the piston. Rotate the input shaft end of the spindle slightly after each ball is inserted. Rotate the spindle in one direction only and do not alternate from clockwise to counterclockwise.

NOTE: When this operation is performed correctly, the spindle and valve body should screw out of the piston and the balls inserted in one recirculating tube hole should appear at the opposite hole. Before proceeding, make certain the balls are at an equal depth in both holes of the piston. This will assure correct installation of the return tube.

Caution: The utmost care must be taken with these steps. Incorrect assembly of this group may result in one or more balls falling inside the piston or coming out at the top and lodging in the housing.

18. Install the remaining seven balls in the recirculating tube halves, and use lithium base grease to retain them in the tube. Seat the assembled tube halves containing the seven balls in the recirculating tube holes in the piston.



Lightly grease the sealing surfaces of the tube cover and install it in the piston making certain the slot in the underside of the cover mates with the recirculating tube in the piston. Install the retaining ring in the piston to secure the tube cover making certain it is completely seated in its groove. After assembly, check for smooth rotation of the spindle assembly in both directions.

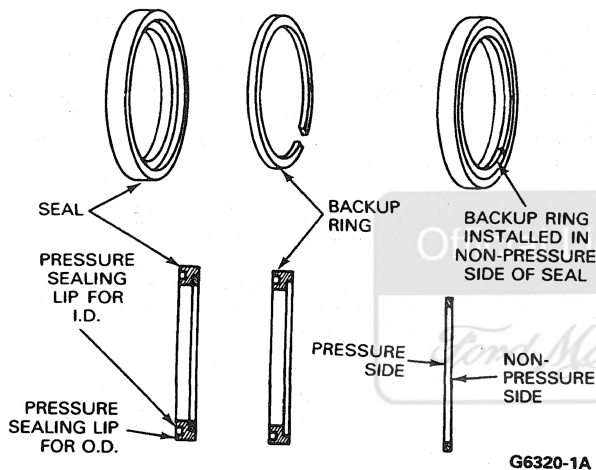
CLEANING AND INSPECTION (Continued)**Housing**

19. Reaching through the side cover opening of the housing, install the seal with its pressure side toward the INTERIOR of the housing.

NOTE: Do not distort this "flexible" seal any more than is necessary for installation.

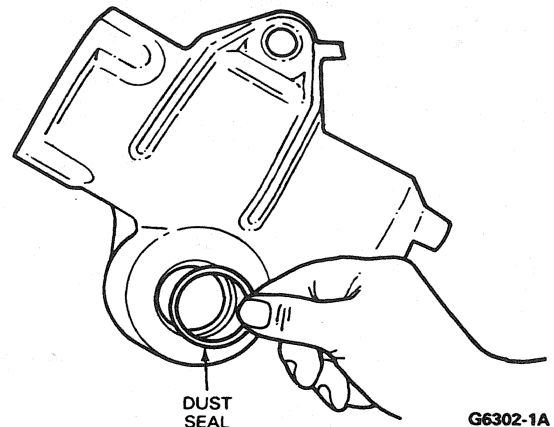
Install the split nylon backup ring, which is a separate part of the seal, in the groove formed by the backside (non-pressure side) of the seal and the housing. Make certain the split ring is completely seated and that the diagonal split surfaces of the ring mate properly.

NOTE: This seal prevents pressurized fluid from leaking out of the housing around the output shaft.

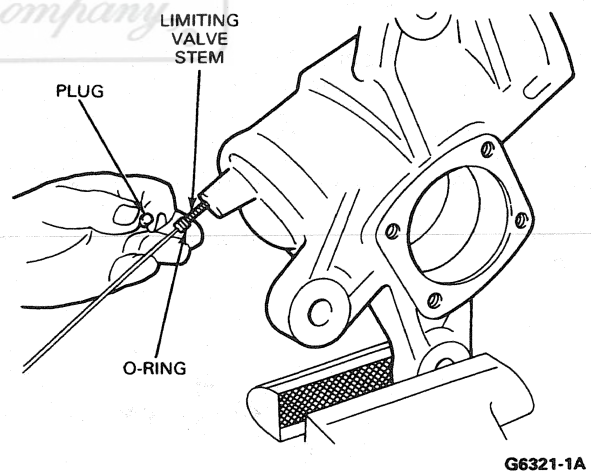


20. Install the dust seal in the housing with its sealing lip toward the OUTSIDE of the housing.

NOTE: This seal is intended to prevent water and dirt from entering the housing.



21. Install the O-ring in the groove around the steering limiting stem and screw the stem into the housing about five or six full turns.

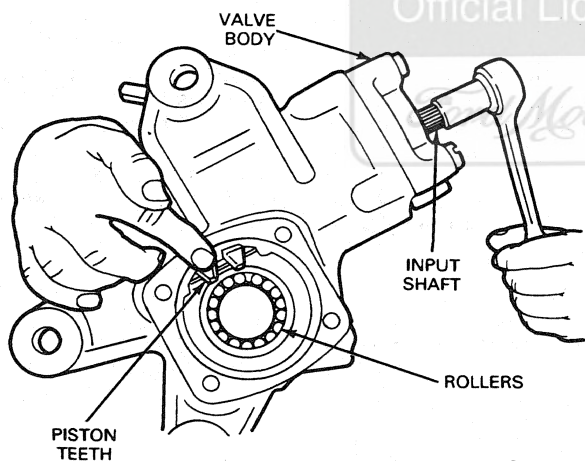


CLEANING AND INSPECTION (Continued)

22. Install the seventeen rollers of the bearing in the outer race contained in the housing. Use a heavy coating of Ford Long Life Lubricant C1AZ-19590-BA or equivalent to hold the rollers in place.

NOTE: The seventeen rollers that are installed must be the same rollers that were removed from this bearing during Disassembly.

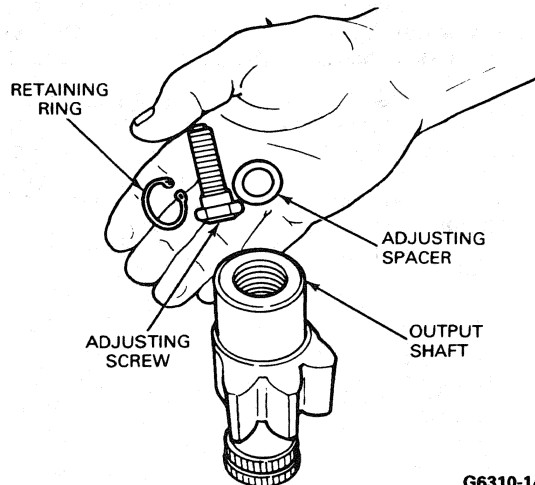
23. Align the steering limiting stem in the valve body with the steering limiting valve seat in the piston. Insert the piston into the housing so that the rack teeth of the piston are visible in the side cover opening in the housing. Make certain that the valve body is oriented in the housing so that the marks made during disassembly align. Slide the piston and valve body assembly completely into the housing taking SPECIAL CARE not to damage the piston glide ring and the valve body O-rings. Secure the valve body to the housing using four bolts. Torque the bolts to 110-119 N·m (81-88 ft-lb) using a 19mm socket and torque wrench. Rotate the input shaft of the spindle until the rack teeth of the piston are centered in the side cover opening in the housing.



G6322-1A

Output Shaft and Side Cover

24. Install the shim washer over the adjusting screw and secure both in the output shaft using the retaining ring.



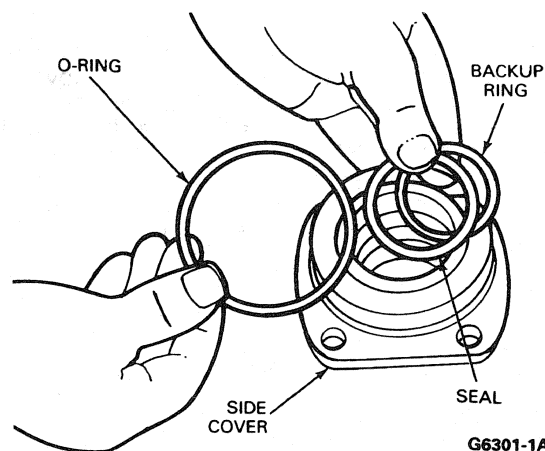
G6310-1A

The maximum end play permitted for these parts is 0.050mm (0.002 inch). If end play is excessive, it may be necessary to install a different shim washer. The shim washer is available in eight different thicknesses to provide the proper end play.

25. Install the seal in the side cover with its pressure side toward the outer race of the side cover roller bearing.

NOTE: This seal prevents fluid leakage around the output shaft. Do not distort this "flexible" seal more than is necessary for installation.

Install the split nylon backup ring, which is a separate part of the seal, by "winding" it into the groove formed by the side cover and the backside of the seal. Make certain the split ring is completely seated and that the diagonal split surfaces of the ring mate properly. Install the O-ring in its groove in the side cover.



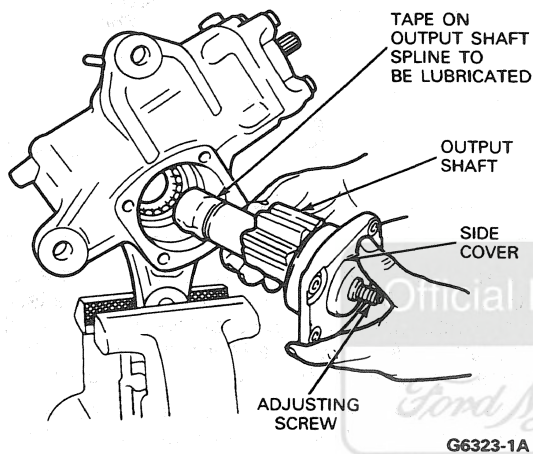
G6301-1A

CLEANING AND INSPECTION (Continued)

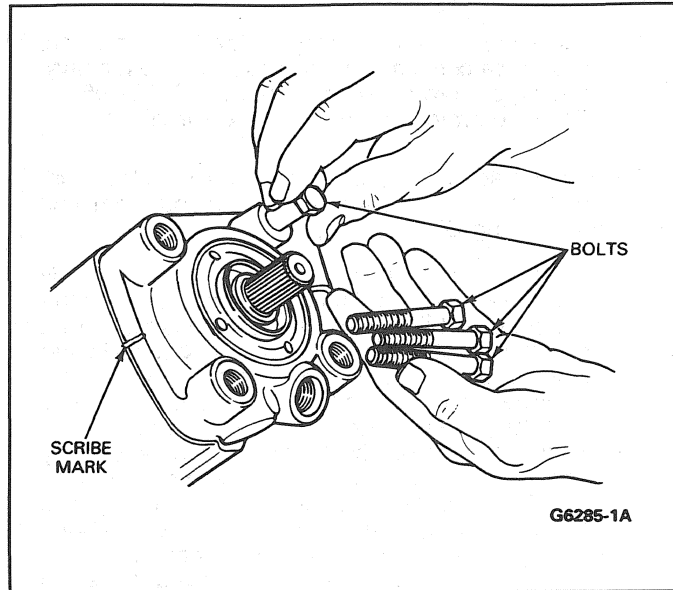
26. Install the seventeen rollers of the bearing in the outer race contained in the side cover. Use a heavy coating of lithium grease to hold the rollers in place.

CAUTION: The seventeen rollers that are installed must be the same rollers that were removed from this bearing during Disassembly.

27. Prior to inserting the output shaft into the housing wrap a single layer of masking tape around the splines to protect the housing seal. Lubricate the exterior of the tape with a lithium grease and insert the shaft and side cover assembly into the housing with a twisting motion. Remove the masking tape from the output shaft splines.



28. Lightly lubricate the seals contained in both the housing and side cover with lithium grease. Lubricate the sealing surface of the output shaft on the adjusting screw end only. Using a 7mm socket wrench install the assembled side cover on the output shaft adjuster screw and screw it on as far as it will go, then back it off 1/8 of a turn.
29. Secure the side cover to the housing using four bolts. Make certain that the side cover is positioned so that the marks made during disassembly are aligned. Torque the bolts to 110-119 N·m (81-88 ft-lb) using a 19mm socket and torque wrench. Pack cavities with lithium grease then install the exterior dust boot on the output shaft and the exterior dust seal on the input shaft.



ADJUSTMENT

Adjusting the Piston to Output Shaft Gear Backlash

1. The piston and output shaft gear backlash is correct when a 0.50-2.0 N·m (4-18 in-lb) increase in torque is noted at the input shaft as it is rotated and the piston passes through the midpoint of its total travel in the housing. The torque increase at the input shaft will occur only as the piston travels through the mid point of its travel and should disappear as the piston moves past the midpoint.

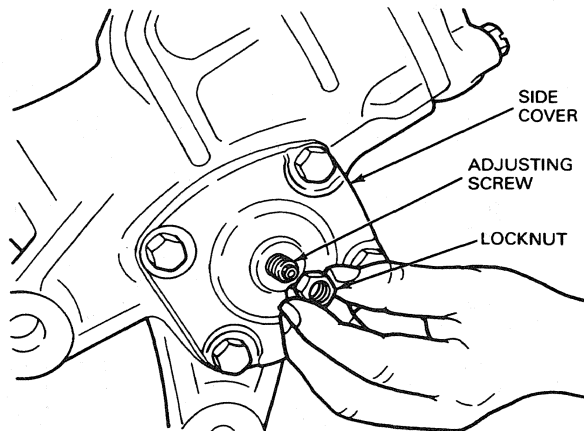
To obtain the adjustment stated above, make certain the adjusting screw is turned counterclockwise as far as it will go. Rotate the input shaft as far as possible in both directions. Count the total revolutions in either direction and at the same time measure the average torque to rotate the shaft.

To obtain the proper backlash adjustment, rotate the input shaft 180 degrees in both directions past the midpoint of piston travel. (The midpoint of piston travel is approximately one half the number of input shaft revolutions possible in a single direction.)

Each time the direction of input shaft rotation is changed, turn the output shaft adjustment screw clockwise 1/8 to 1/4 turn. Continue this procedure until a 0.50-2.0 N·m (4-18 in-lb) increase is noted in the torque required to rotate the input shaft.

ADJUSTMENT (Continued)

2. When the adjustment is correct, install lock nut and tighten to 100-119 N·m (74-88 ft-lbs) with a 19mm crow foot and torque wrench while holding the adjustment screw in position with the 7mm socket and torque wrench.



G6324-1A

3. After all the described steps have been performed, check that the power steering unit runs smoothly throughout its entire motion and that the backlash at the center position is as prescribed in Step 30.
4. Install the C-300N power steering gear on the vehicle. Fill gear with fluid and purge air as detailed in Section 13-01, General Steering Service. Test for flow, leakage and the pressure relief valve setting as well as setting the stroke limiting as detailed in Section 13-01 under Start-Up Procedure (After Power Steering Pump or Gear Overhaul).

Adjusting the Stroke Limiting Stem

The function of the optional steering limiting feature is to relieve most of the hydraulic power assist prior to the piston reaching the end of its full travel in either direction. This ensures that the axle stops are not impacted with full hydraulic assist when a full wheel cut is made in either direction.

The C-300N has two adjustable steering limiting stems of which only one is externally adjustable. The internal adjustable stem must be preset during assembly to meet vehicle requirements.

The following instructions are for the externally adjustable steering limiting stem.

1. Adjust the axle stops using the vehicle specifications, and the Rotunda Power Steering System Analyzer 014-00230.
2. Install a pressure gauge or gauge and flow meter combination in the pressure (supply) line between the power steering pump and steering gear.

Caution: During the procedure that follows use extreme care not to operate the power steering pump at its relief valve pressure for more than a few seconds at a time. Extended operation at pump relief pressure will result in excessive heat and subsequent damage to the system. A thermometer installed in the pump reservoir will allow temperature checks to assure the maximum pump and gear temperatures are not exceeded.

3. Start the engine and gently turn the steering wheel to the axle stop in both directions while observing the pressure gauge and the direction of the wheel cut (right or left). This procedure should reveal which turning direction (either right or left) the externally adjustable steering limiting stem is intended to adjust. The desired reaction is described in "A" below.

- A. In one turning direction, gauge pressure should drop substantially just prior to the steering mechanism contacting the axle stop. In the other turning direction, the gauge should register pump relief valve pressure as the steering mechanism contacts the axle stop. The turning direction that registers pump relief is the one controlled by the externally adjustable steering limiting stem.
- B. If gauge pressure does not drop prior to axle stop contact in either direction the internally adjustable steering limiting stem or valve is not functioning properly.
- C. If gauge pressure drops prior to axle stop contacts in both directions, turn the externally adjustable stroke limiting stem counterclockwise and repeat the test until reaction "A" is obtained.

4. Return the steering to a neutral straight ahead position and turn the externally adjustable stroke limiting stem clockwise to its full travel.
5. Gently turn the steering wheel in the direction effected by the externally adjustable stroke limiting stem until the axle stop is contacted. Pressure registered on the gauge should be relatively low.

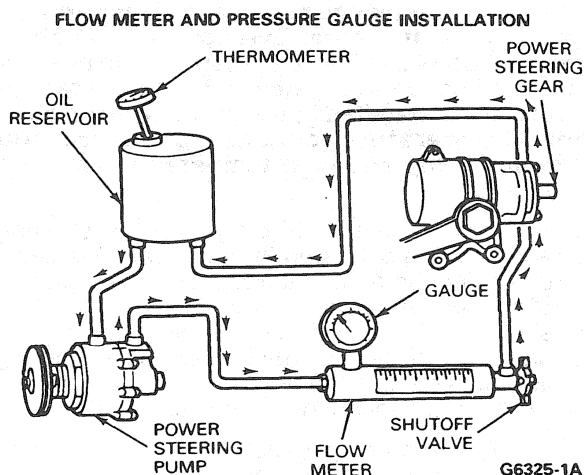
With the steering wheel held to maintain axle stop contact, turn the stroke limiting stem counterclockwise until the gauge pressure JUST begins to rise or until the gauge pressure specified by the vehicle manufacturer is obtained.

NOTE: A rise in pressure on the gauge while turning the stroke limiting stem counterclockwise indicates that the stroke limiting valve is beginning to close. Continued turning of the stem will cause the valve to close and the pressure to rise until the valve is completely closed and the pressure rises to the pump relief setting.

6. After adjustment of the stroke limiting is complete, install the plug in the stem bore in the housing.

ADJUSTMENT (Continued)

On-Vehicle Power Steering Tests



Perform the power steering pump performance tests specified in Section 13-01, General Steering Service. Make certain that system back pressure, maximum and minimum pump flow and pump relief pressure all meet specified requirements.

Testing the Power Steering Gear Pressure Relief Valve

1. To prevent the operation of the steering limiting valves, if the gear is so equipped, place a steel spacer block between the axle stop and the adjusting screw. The block should be a minimum of one inch thick and long enough to be inserted without danger of pinching fingers. Keep fingers clear of pinch points and be sure block is square to points of contact.

WARNING: FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SERIOUS INJURY OR DAMAGE TO THE EQUIPMENT.

2. Check fluid temperature in the reservoir. Thermometer reading should be approximately 54.5°C (130°F) at start of the test and the shut off valve on the flow meter must be totally open.
3. Turn the steering wheel until the axle stop contacts the spacer block. Apply sufficient torque to the steering wheel to ensure the power steering gear control valve is completely open in the direction of the turn. At this time the pressure gauge will read the gear pressure relief setting. If the pressure reading is 13100-14480 kPa (1900-2100 psi) the pressure relief valve is operating properly. If the pressure is outside of this range, the pressure relief valve should be adjusted or repaired as necessary.

CAUTION: When running this test, do not hold the torque on the steering wheel for more than 5 seconds beyond the time the pressure relief setting has been reached. It may damage the unit or cause the temperature of the oil to raise beyond 93°C (200°F).

Testing the Power Steering Gear for Internal Leakage

NOTE: Excessive internal leakage past seals and O-rings will generally be manifested by an increase in steering effort especially when steering quickly to the right or left. The tests that follow can be used to confirm this symptom.

1. If the power steering gear is equipped with a pressure relief valve, it will be necessary to **TEMPORARILY** adjust its setting above that of the power steering pump relief valve. To adjust the power steering gear pressure relief valve:
 - A. With the engine stopped, remove the pressure relief valve plug and its sealing washer.
 - B. Install approximately 0.762-1.524mm (0.030-0.060 inch) additional shims in the socket portion of the plug.
 - C. Reinstall the plug and its seal washer along with the additional shims. Torque the plug to 89-99 N·m (66-73 ft-lb) using a 26mm socket.
2. To prevent the operation of the steering limiting valves, if the gear is so equipped, place a steel spacer block between the axle stop and the adjusting screw. The block should be a minimum of one inch thick and long enough to be inserted without danger of pinching fingers. Keep fingers clear of pinch points and be sure block is square to points of contact.

WARNING: FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SERIOUS INJURY OR DAMAGE TO THE EQUIPMENT.

3. Run the engine at idle. Turn the steering wheel until the axle stop contacts the spacer block. Apply a sufficient torque to the steering wheel to ensure the power steering gear control valve is completely open in the direction of the turn. Observe the following:
 - A. Gauge pressure should read the same as the power steering pump relief pressure.
 - B. With system pressure at pump relief, read the flow meter. If a flow greater than 3.8 Liters (1 gallon) per minute is noted, internal leakage is excessive and the steering gear requires repair.

CAUTION: When running this test, do not hold the torque on the steering wheel for more than 5 seconds beyond the time the pressure relief setting has been reached. It may damage the unit or cause the temperature of the oil to raise beyond 93°C (200°F).

4. Repeat Step 3—turning the steering wheel in the opposite direction.

NOTE: Before returning this vehicle to service, remove the shims which were installed in Step 1.

SPECIFICATIONS

C-300N STEERING GEAR TORQUE SPECIFICATIONS

Description	N-m	Ft-Lbs
Steering Gear to Frame Rail Bolts	203-278	150-205
Intermediate Shaft to Gear Input Shaft	68-95	50-70
Pitman Arm to Gear Output Shaft Nut	299-406	220-300
Pressure Relief Valve Seat	20-24	15-18
Pressure Relief Valve Plug	89-99	66-73
Input Shaft Valve Nut	300-348	221-257
Valve Body to Housing Bolts	110-119	81-88
Side Cover Bolts	110-119	81-88
Output Shaft Adjustment Screw Lock Nut	100-119	74-88
Description	N-m	In-Lbs
Steering Limiting Valve Seats	10-15	88-132

CG6326-1A

C-300N OPERATIONAL SPECIFICATIONS

Steering Ratio (Input to Output Shaft)	21.2:1
Steering Wheel Revolutions for 90 Degree Rotation of Output Shaft	5.3
Maximum Output Shaft Rotation	75° (Power Assisted) 95° (Maximum Travel)
Maximum Output Shaft Torque with 1992 psi (140 Kg/CM) Power Assist	1985 Ft-Lb (270 mdaN)
Power Steering Fluid	Dexron II, Type DXT-2-QDX or Equivalent
Maximum Working Temperature	120°C (248°F)
Maximum Peak Temperature	150°C (302°F)
Maximum Working Pressure	2050 psi (141.5 Bar)
Maximum Pressure Drop in the Return Line	43 psi (3 Bar)
Normal Flow	4.2 GPM (16 L/min)

CG6327-1A

SPECIAL SERVICE TOOLS

Number	Description
106234①	Spanner Wrench
297676①	Seal Seating Tool
Fabricate②	Seal Driver 1.55 Inch Diameter
298080①	Piloted Screw Driver
297678①	Holding Fixture
014-00230③	Power Steering System Analyzer

① Available from Bendix HVSD, 901 Cleveland, Elyria, Ohio 44116, attn: After Market Service Division.

② Use a suitable seal driver, or fabricate one from the information given in the text.

③ Available from Rotunda Tools.

CG6328-1A

SECTION 13-57 Power Steering Pump — ZF

SUBJECT	PAGE
DESCRIPTION AND OPERATION	13-57-1
DIAGNOSIS AND TESTING	13-57-1
DISASSEMBLY AND ASSEMBLY	
Power Steering Pump	13-57-3
REMOVAL AND INSTALLATION	
Filter Element	13-57-5

SUBJECT	PAGE
REMOVAL AND INSTALLATION (Cont'd.)	
Power Steering Pump — Belt Drive	13-57-1
SPECIFICATIONS	13-57-7

DESCRIPTION AND OPERATION

The ZF power steering pump has been specially designed to supply pressurized oil to power steering units.

The ZF power steering pump is directly driven by the engine. As the driven shaft rotates the rotor, the slipper vanes inside the pump also move. The centrifugal force and pressurized oil forces the slipper vanes against the track of the cam ring. The oil passes from the two pressure chambers to the area between the rear cover and faceplate, thus pressing this plate against the cam ring at operating pressure. The oil then passes through a flow-limiting valve to the pressure line.

DIAGNOSIS AND TESTING

Refer to Section 13-01, General Steering Service for diagnostic and testing procedures.

REMOVAL AND INSTALLATION

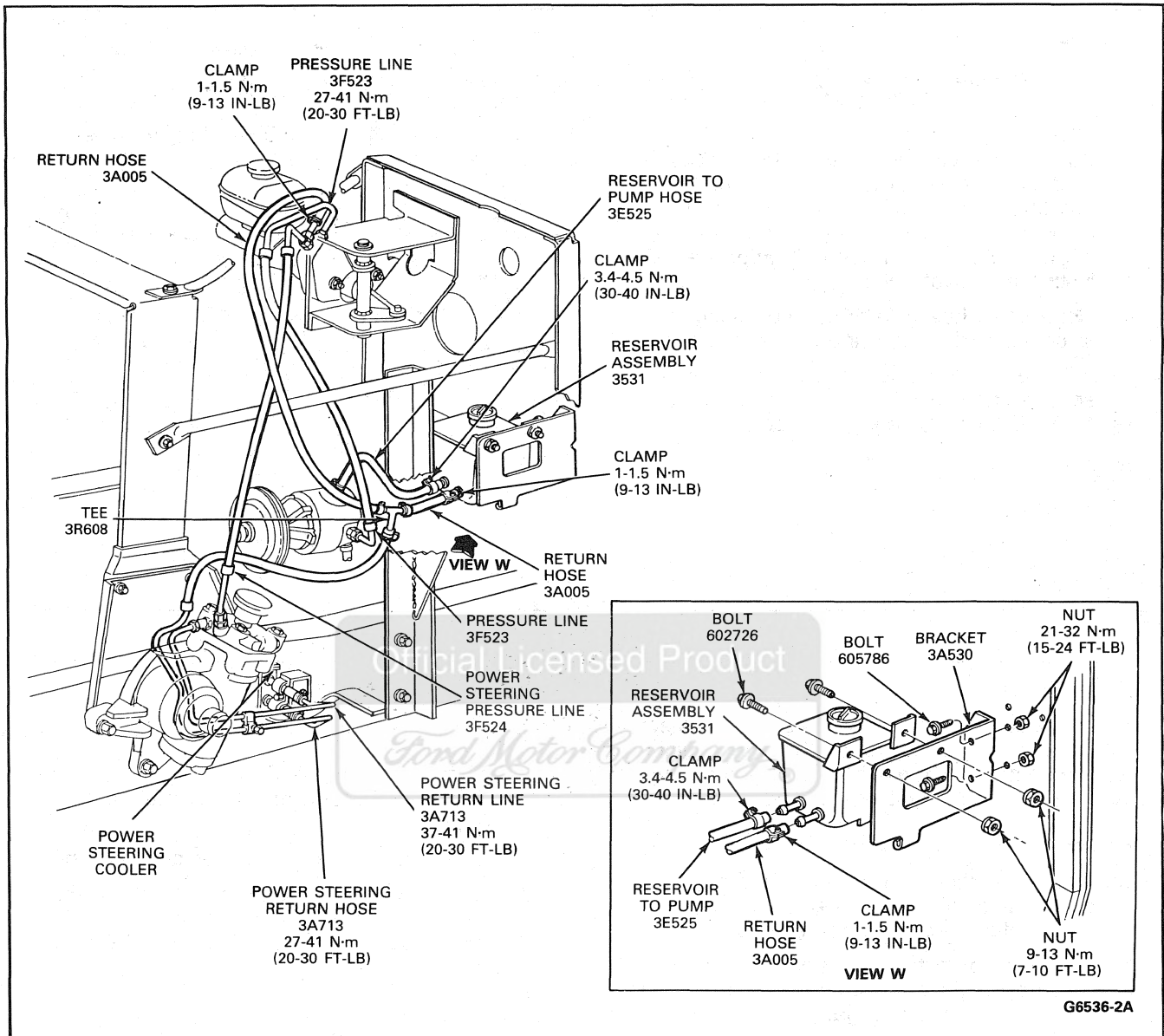
Always tag pump hoses before removal so they can be easily connected to their proper ports during installation.

Power Steering Pump — Belt Drive

Removal

1. Using a suction gun, remove as much fluid as possible from the reservoir through the filler opening or remove the return hose to drain the reservoir.
2. Disconnect both hoses from the pump. Fasten both hoses in a raised position or plug disconnected ends to prevent the fluid from draining out.
3. Loosen the power steering pump pivot bolt and adjusting bolt. Remove the drive belt.
4. Remove the two power steering pump mounting bolts and remove the complete pump assembly.

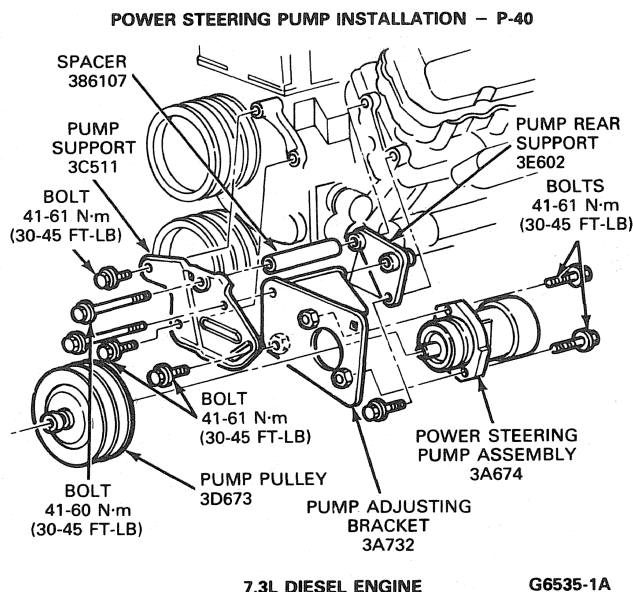
REMOVAL AND INSTALLATION (Continued)



REMOVAL AND INSTALLATION (Continued)

Installation

1. Install the pump assembly and tighten the pump mounting bolts to 41-61 N·m (30-45 ft-lb).
2. Adjust the pump belt tension to 490-662 N (110-140 lb) per strand on new belts, or 401-533 N (90-120 lb) per strand on used belts, using belt tension gauge tool T63L-8620-A or equivalent. Tighten the adjusting and pivot bolts.
3. Connect all hoses to the pump, being sure to connect all lines to the correct ports.
4. Fill the reservoir to specification as described under Fluid Level Check In Section 13-01, General Steering Service.



Filter Element

NOTE: After a major power steering system failure due to a pump or gear damage requiring replacement or major overhaul, the system must be purged and a new filter installed.

Removal

1. Using a suction gun, remove fluid from the reservoir through the filler opening or remove return hose to drain reservoir.
2. Remove cover from reservoir by holding down spring loaded cover and removing wing nut, washer and gasket.

3. Take out spring, filter cap and filter.

Installation

1. Install replacement filter, filter cap and spring.
2. Install gasket, cover, washer and wing nut.
3. Fill reservoir to the cold mark with specified automatic transmission fluid, Motorcraft DEXRON-II®, Series D (XT-2-QDX) or equivalent.

DISASSEMBLY AND ASSEMBLY

Power Steering Pump

Disassembly

Clean all dirt and oil from the external surface of the pump after removal. Handle all pump parts carefully to avoid nicks, burrs, scratches and dirt.

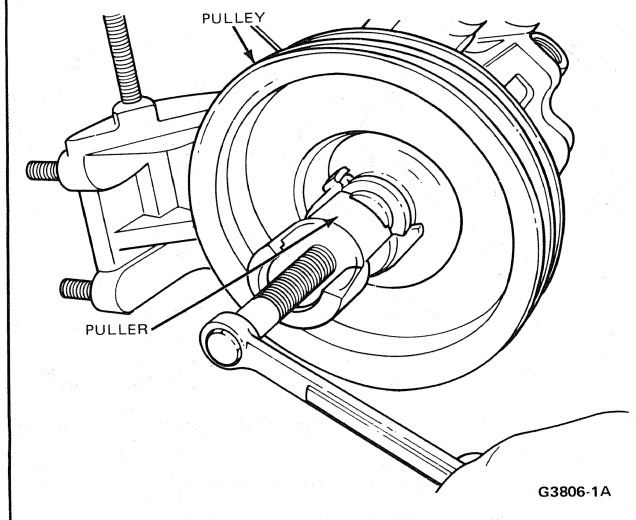
CAUTION: To assure correct reassembly, record or mark all information as specified in the procedure.

1. For pumps with remote reservoirs, tip the pump to drain oil from the intake tube. Rotate shaft to remove oil from internal cavities.
2. Using the pump mounting bracket, clamp the pump assembly into a bench vise in such a position as to facilitate pump disassembly.

CAUTION: Do not clamp on the pump or pulley.

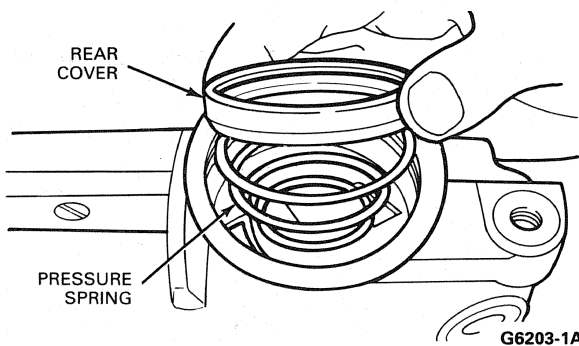
DISASSEMBLY AND ASSEMBLY (Continued)

3. Remove pulley with appropriate puller such as T69L-10300-B or equivalent.

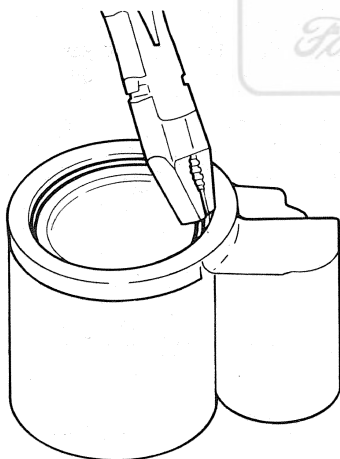


6. Remove cover and pressure spring. Remove internal O-ring and backup ring from rear cover.

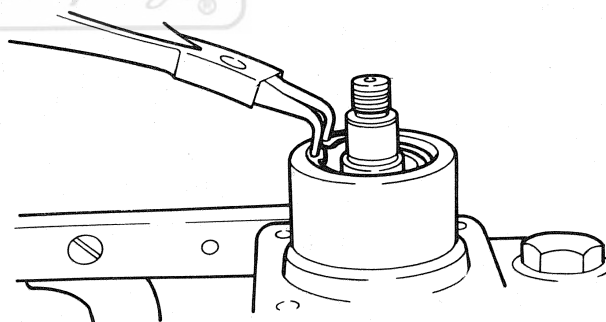
NOTE: O-ring is inboard of backup ring.



4. Compress rear pump cover.
5. Remove hook spring ring from radial groove in housing using pliers.



7. Remove the circlip from the groove.

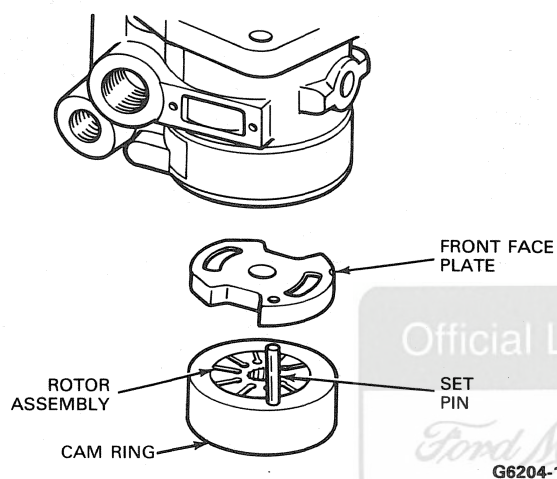


DISASSEMBLY AND ASSEMBLY (Continued)

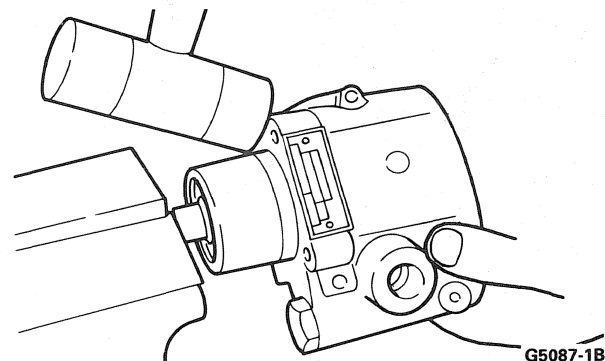
8. Turn the housing over and remove the rear face plate. Remove O-ring and backup ring for the rear face plate from the housing. Remove the rotor assembly (rotor, cam ring, vanes and set pin) and front face plate from the housing.

NOTE: This O-ring is outboard of the backup ring.

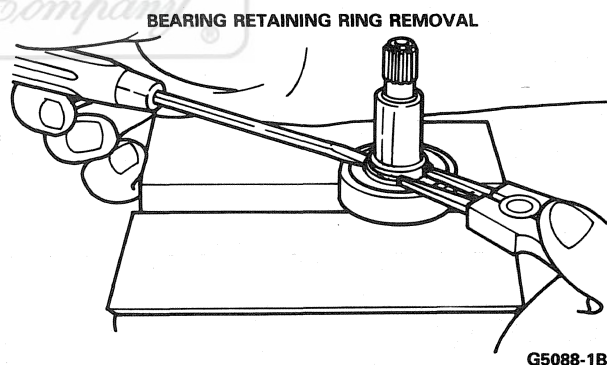
NOTE: Check direction of rotation (arrow on cam ring) and location of the set pin:



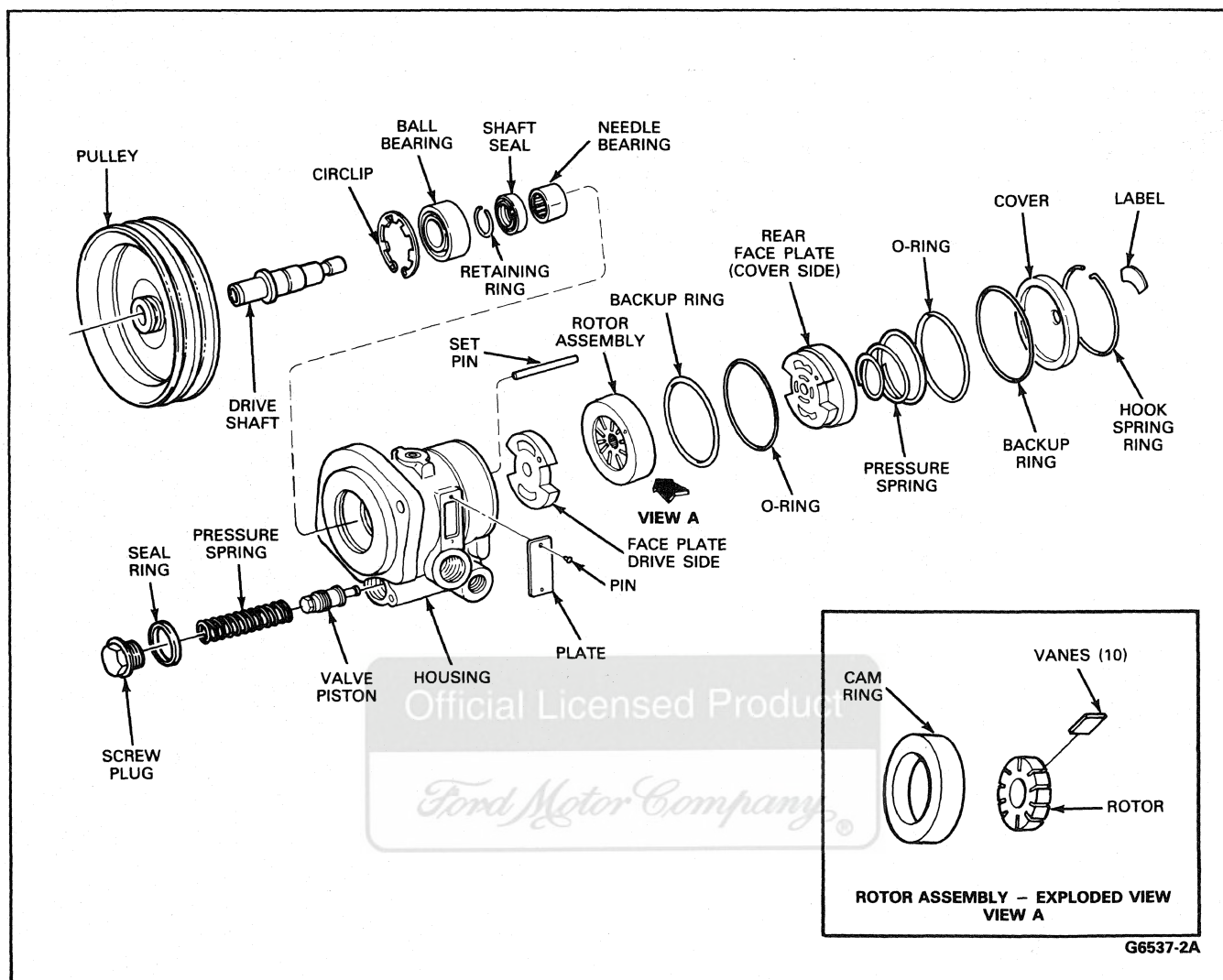
9. Clamp driveshaft in vice (use soft jaws) and with a soft mallet, tap on the housing to remove the driveshaft from the housing.



10. If the ball bearing is to be replaced, remove the retaining ring and press the bearing from the driveshaft.
11. If the shaft seal requires service, pry the seal from the housing. Discard the seal. If the needle bearing requires service, press the needle bearing from the housing.



DISASSEMBLY AND ASSEMBLY (Continued)

**Assembly**

1. If removed, press in a new needle bearing.
2. If removed, install a new shaft seal in the housing.
3. If removed, press a new bearing onto the driveshaft. Install the retaining ring in the driveshaft groove.
4. Install the driveshaft and bearing assembly into the housing.
5. Install the bearing circlip in the groove.
6. Install O-ring and backup ring on the rear faceplate in accordance with exploded view.
7. Install the set pin, front faceplate and rotor assembly into the housing.

NOTE: The cam ring of the rotor assembly must be installed with the arrow pointed in the direction of rotation.

8. Install the O-ring and backup ring in the rear cover housing in accordance with exploded view. Place the rear pressure spring in the rear face plate. Position the rear cover in the housing.
9. Press down on the rear cover plate and install the hook spring ring in the groove in the housing.
10. Press on the pulley with Tool-T-65-P-3A733, or equivalent.

SPECIFICATIONS**SPECIAL SERVICE TOOLS**

Tool Number	Description
T63L-8620-A	Belt Tension Gauge
T69L-10300-B	Steering Pump Pulley Remover
T65P-3A733-C	Pump Pulley Replacer

CG6349-1A

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Ford Motor Company®

SECTION 14-01 General Suspension Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	14-01-1	SPECIFICATIONS	14-01-1

DESCRIPTION

For suspension service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 14-01, General Suspension Service in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Caster and Camber Adjustment .. 14-01-9

Front Wheel Alignment

Adjustments 14-01-6

DIAGNOSIS AND TESTING

Checking Front Wheel

Alignment 14-01-4

Front End Alignment Checks 14-01-1

Vehicle Lean Checks 14-01-4

DIAGNOSIS GUIDES

Caster and Camber Adjustment .. 14-01-9

Checking and Adjusting Toe

Alignment 14-01-9

Shock Absorber Checks 14-01-14

Spindle Arm Stop Adjustments .. 14-01-10

Steering Stop 14-01-10

Vehicle Lean Correction 14-01-12

SPECIFICATIONS

Official Licensed Product

ALIGNMENT SPECIFICATIONS

Truck Model (Axle)	Alignment Factors	Alignment Specifications					Standard Vehicle Attitude (Ref)				Remarks	
		At Design Ride Height (Ref.)	Curb Ride Height				Lateral Tilt (3) (Side To Side Height Differences)			Dog-Track		
			Preferred Setting	Checking Range (2)		Maximum Variation Between Wheels	Front Top of Frame	Rear Top of Frame At RR Wheels	Rear Top of Frame At End Of Frame			C of Front Tread To C of Rear Tread
				Min.	Max.							
F-Super Duty Stripped Chassis Mono Beam (4x2)	Caster Camber Toe (2 wheel Total) SAI angle	4.7° + 0.6° — 9.0°	(1) 1/32° In —	(4) 3/32° Out	(4) 5/32° In	1.5° 0.7°	15mm	20mm	20mm	30mm	Turn Angles — Set Inside Wheel to 40°	

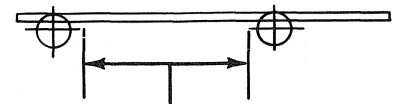
(1) See caster curve, caster setting depend on ride height dimension "A"

(2) The range of measured caster angles that are within specification are for a measured ride height dimension "A"

(3) Lateral vehicle tilt specifications are max., allowable for either:

- Vehicle at curb weight without occupants or
- Vehicle loaded (not exceeding GVW) with equally distributed weight over the cargo and occupant areas

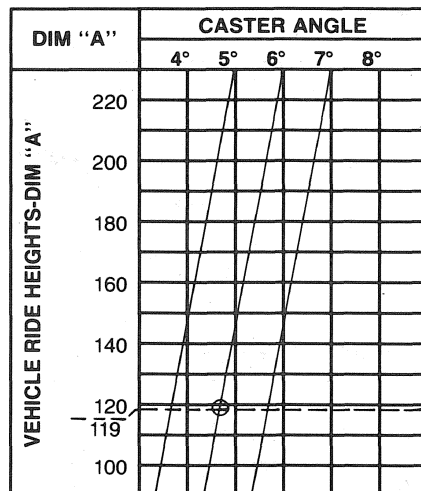
(4) The charted caster angles are not compensated for frame angle. Therefore, when checking measured caster angles to specification charts you must add (or subtract) the measured frame angle to the measured caster angle and compare this sum to the charted value. Add frame angle to measured caster angle if vehicle tilts down in front. Subtract frame angle from measured caster if vehicle up in front.



AREA OF LOWER FRAME RAIL TO BE USED FOR "FRAME ANGLE" MEASUREMENT

CF6456-2A

SPECIFICATIONS (Continued)

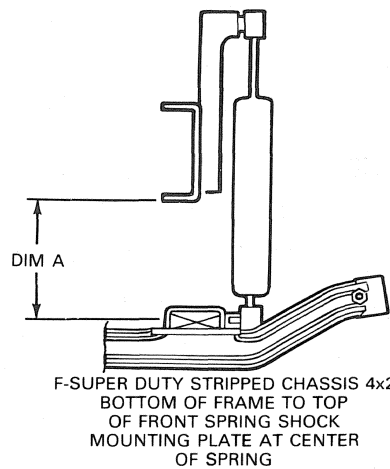


DESIGN RIDE
HEIGHT (REF)

F SUPERDUTY STRIPPED CHASSIS 4x2

SPECIFICATIONS:
MAX. SIDE TO SIDE VARIATION
IN CASTER AND CAMBER ANGLES IS
1.5° FOR CASTER AND 0.° FOR CAMBER

CF6463-1A



F6465-1A

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SECTION 14-21 Front Suspension

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Camber Adjustment	14-21-1	Front Shock Absorber	14-21-2
DESCRIPTION		Front Spring	14-21-4
Front Axle	14-21-1	Front Stabilizer Bar	14-21-3
Front Suspension	14-21-1	Front Wheel Spindle	14-21-4
REMOVAL AND INSTALLATION		SPECIFICATIONS	14-21-8
Front Axle	14-21-8		

DESCRIPTION

Front Axle

F-Super Duty Commercial Stripped Chassis vehicles use a solid I-beam type front axle that is attached by two leaf springs to both frame side rails. The springs are mounted to the axle by U-bolts.

Front Suspension

These vehicles use two leaf springs attached to a solid I-beam front axle. The springs are

mounted to the front axle with U-bolts and are attached to the frame side rails using a "fixed" bracket at the front and a moveable shackle at the rear.

The spindles are held in place by spindle pins which pivot in bronze bushings pressed in the upper and lower ends of the spindle. A thrust bearing is installed between the lower end of the axle and the spindle to support the load on the axle.

ADJUSTMENTS

NOTE: Do not attempt to change the camber by bending the axle beam. Camber angle is not adjustable.

REMOVAL AND INSTALLATION

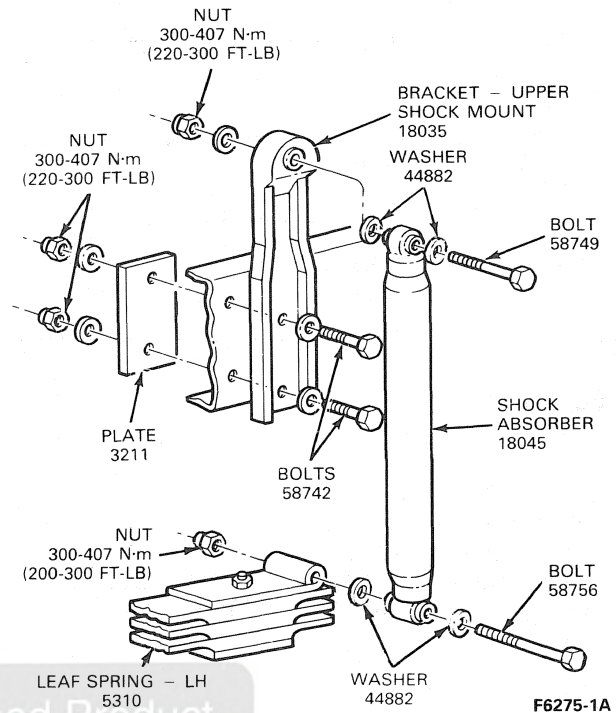
Front Shock Absorber

Removal

1. Remove the nut and bolt that retains the shock absorber to the upper shock bracket.
2. Remove the nut and bolt that retains the shock absorber to the eye on the spring spacer.
3. Remove the shock absorber from the vehicle.

Installation

1. Position the shock absorber in the upper shock bracket. Install the nut and bolt and tighten to 300-407 N•m (220-300 ft-lb).
2. Position the lower end of the shock absorber to the spring spacer eye. Install the nut and bolt and tighten to 300-407 N•m (220-300 ft-lb).



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REMOVAL AND INSTALLATION (Continued)

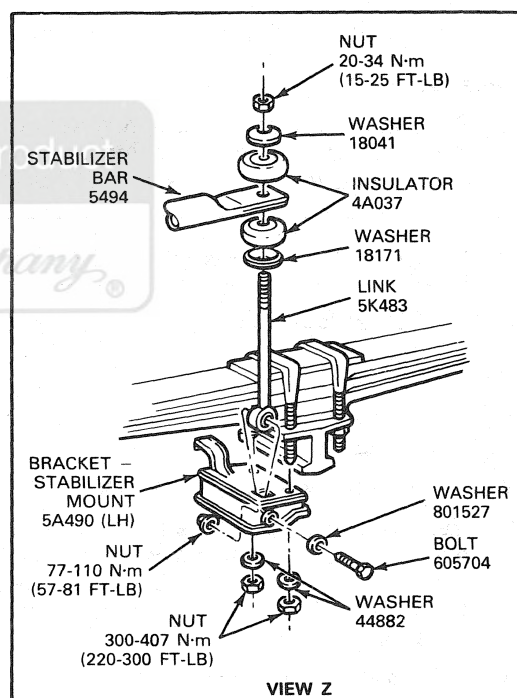
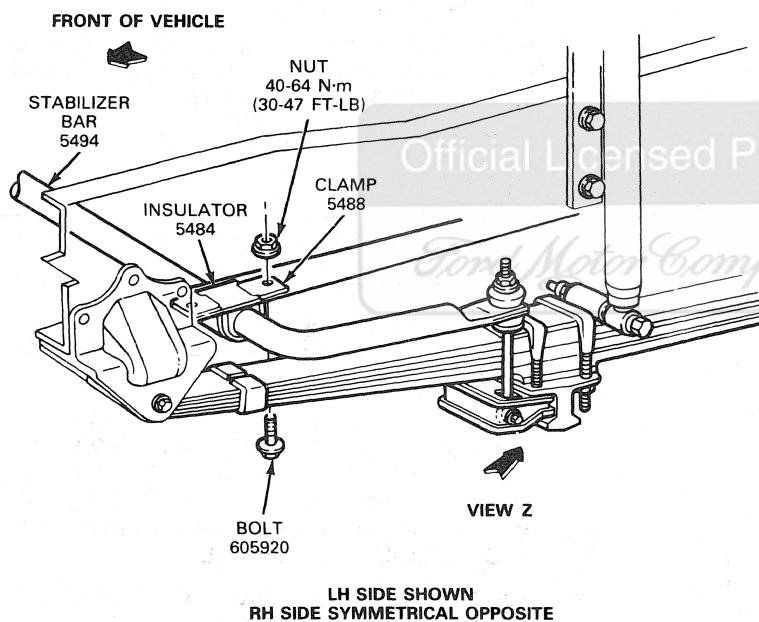
Front Stabilizer Bar

Removal

1. Disconnect the left and right ends of the front stabilizer bar from the link assembly attached to the front axle.
2. Remove the nuts and bolts connecting the stabilizer bar to the frame. Remove the stabilizer bar.
3. Disconnect the stabilizer bar link assemblies by removing them from the axle mounting brackets.

Installation

1. Loosely assemble the entire stabilizer bar system with both link assemblies loosely attached to the axle mounting brackets, and the stabilizer bar in position on the frame.
2. Check to be sure that the stabilizer bar insulators are seated in the retainers and that the stabilizer bar is centered on the frame. Attach the stabilizer bar to the frame by assembling the retainers to the frame mounts. Tighten the bolts to 40-64 N·m (30-47 ft-lb).
3. Install the link assemblies to the axle mounting brackets using the bolts, washers and locknuts. Tighten to 77-110 N·m (57-81 ft-lb).
4. Install the link assemblies to the stabilizer bar with 2 cup washers, 2 rubber insulators and 1 locknut. Tighten the locknut to 20-34 N·m (15-25 ft-lb).



F6451-2A

REMOVAL AND INSTALLATION (Continued)**Front Spring****Removal**

1. Raise the vehicle frame until the weight is off the front springs with the wheels still touching the floor.
2. Support the front axle with jacks to remove the weight from the spring U-bolts.
3. Remove the nut and bolt that holds the shock absorber to the spring spacer eye. Disconnect the shock absorber from the spring spacer.
4. Remove the nut and bolt that retains the spring to the front spring shackle.
5. Remove the nut and bolt that retains the spring to the rear spring shackle.
6. Remove the four U-bolt nuts. Remove the stabilizer bar bracket. Remove the U-bolts.
7. Remove the spring from the vehicle.

Installation

1. Position the spring at the spring seat on the front axle and align the spring eye with its mating hole in the front spring shackle.

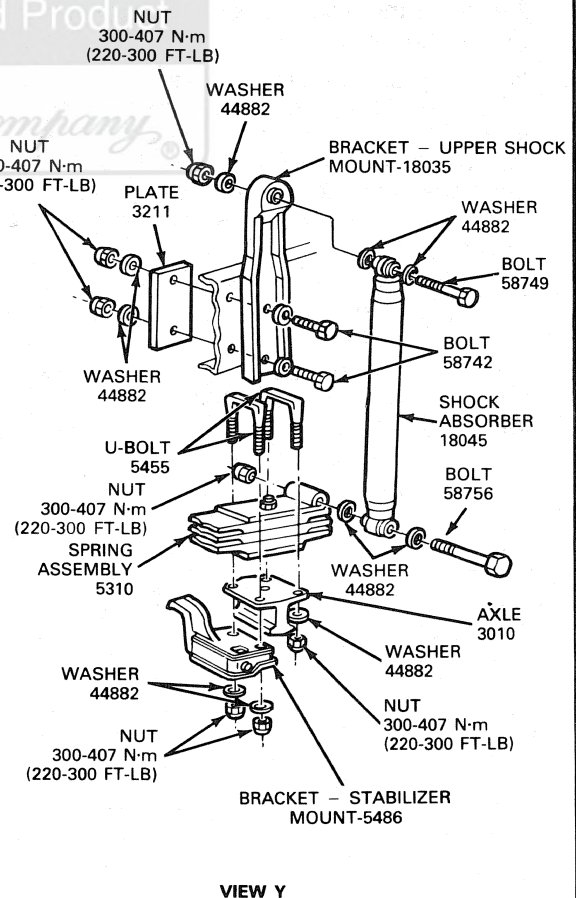
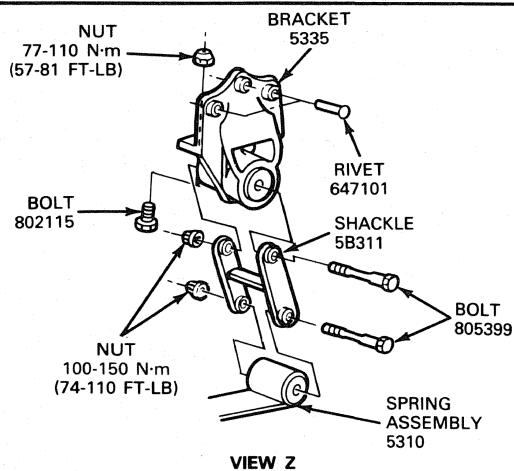
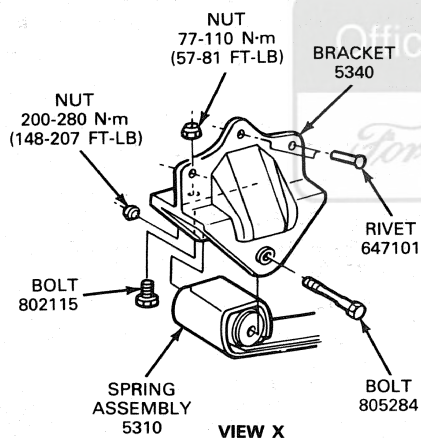
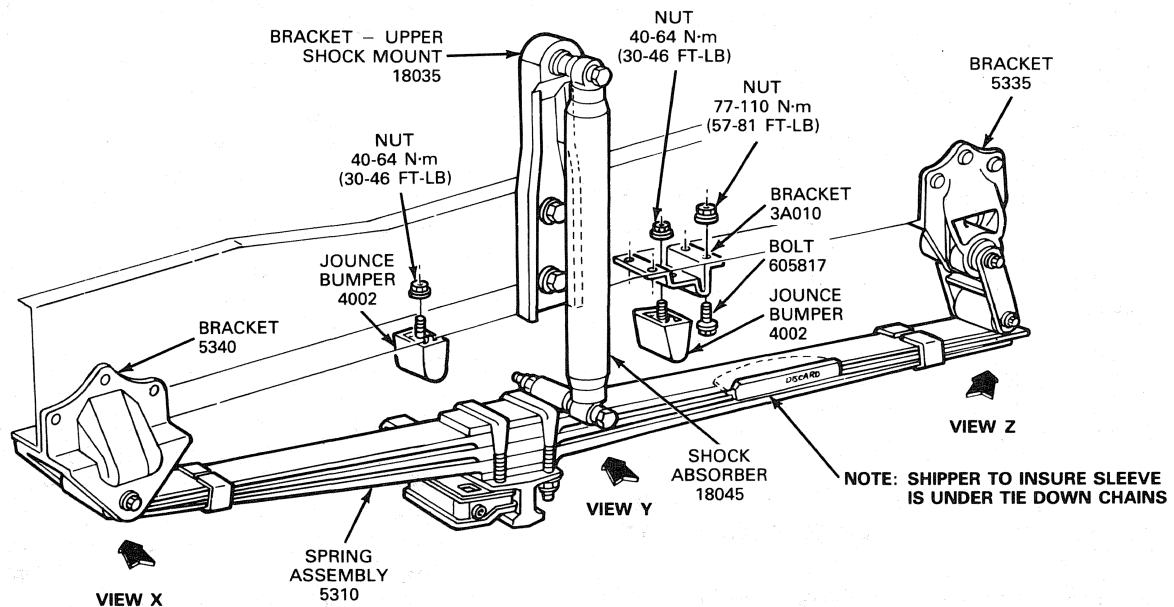
2. Prior to installation, coat the bushing with Long Life Lubricant C1AZ-19590-BA (ESA-M1C75-B) or equivalent. Gently guide the bolt through the shackle and spring eye.
3. Install the retaining nut. Tighten to 200-280 N•m (148-207 ft-lb).
4. Align the rear spring eye with its mating hole in the rear spring shackle.
5. Coat the bushings with Long Life Lubricant C1AZ-19590-BA (ESA-M1C75-B) or equivalent. Gently guide the bolt through the shackle and spring eye. Tighten to 100-150 N•m (74-110 ft-lb).
6. Position the spring spacer on the locating boss in the spring.
7. Install the U-bolts. Install the stabilizer bracket on the forward U-bolt. Install the four U-bolt nuts and tighten to 300-407 N•m (220-300 ft-lb).
8. Install the shock absorber to the spring spacer eye. Install the bolt and nut, and tighten to 300-407 N•m (220-300 ft-lb).
9. Remove the jacks from under the front axle.
10. Lower the vehicle.

*Ford Motor Company***Front Wheel Spindle****Removal**

1. Raise the front of the vehicle and install safety stands.
2. Remove the wheel and tire assembly.
3. Remove the caliper assembly from the rotor and hold it out of the way with wire. Refer to Caliper Removal instructions in Section 12-24, Disc Brakes — Light and Heavy Duty — Sliding Caliper.
4. Remove the dust cap, cotter pin, nut retainer, nut, washer, and outer bearing, and remove the rotor from the spindle.
5. Remove inner bearing cone and seal. Discard the seal.

6. Remove brake dust shield. Refer to Section 12-24, Disc Brakes — Light and Heavy Duty — Sliding Caliper.
7. Disconnect the steering drag link from the steering arm, and the tie rod from the steering arm by removing the cotter pin and nut, and then removing the steering drag link and tie rod from the steering arms with TOOL-3290-D or equivalent.
8. Remove the nut and lockwasher from the lock pin, and remove the lock pin.
9. Remove the upper and lower spindle pin plugs; then, drive the spindle pin out from the top of the axle and remove the spindle and thrust bearing. Remove the spindle pin seal and thrust bearing.

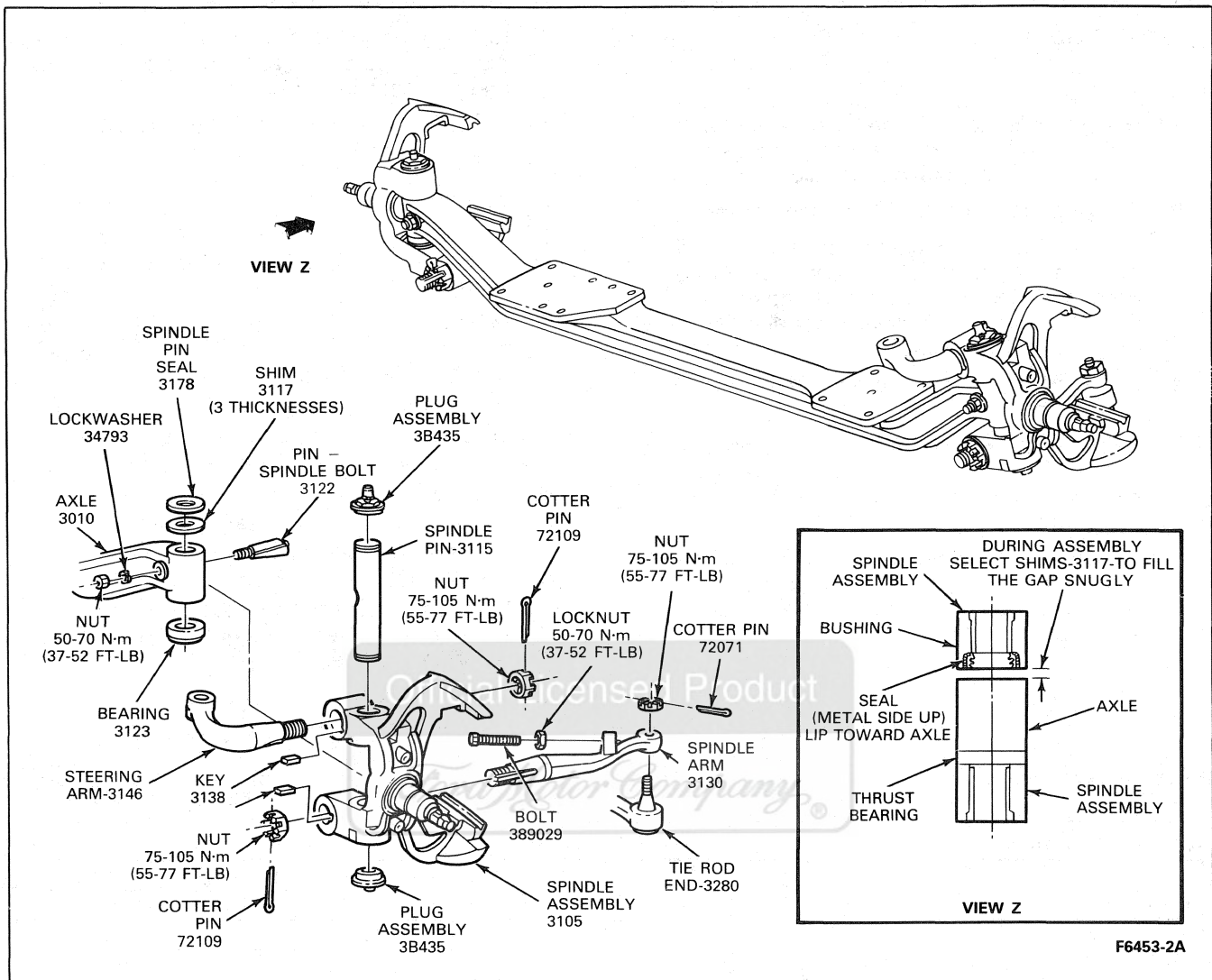
REMOVAL AND INSTALLATION (Continued)



REMOVAL AND INSTALLATION (Continued)**Installation**

1. Make sure the spindle pin hole in the axle is free of nicks, burrs, corrosion or foreign material. Clean up the bore as necessary and lightly coat the surface with a lithium-base grease, Long-Life Lubricant, C1AZ-19590-BA (ESA-M1C75-B) or equivalent.
2. Install a new spindle pin seal with the metal backing facing up towards the bushing into the spindle as shown. Gently press seal into position, being careful not to distort the casing.
3. Install a new thrust bearing with the lip flange facing down towards the lower bushing as shown. Press until the bearing is firmly seated against the surface of the spindle.
4. Lightly coat the bushing surfaces with grease and place the spindle in position on the axle.
5. Hold the spindle with thrust bearing in place tight against the axle and measure the space between the axle and the spindle at the top of the axle. Select the proper shims (3117) and install.
6. Install the spindle pin with the "T" stamped on one end towards the top, and the notch in the pin aligned with the lock pin hole in the axle. Insert the spindle pin through the bushings and axle from the top until the spindle pin notch and axle lock pin hole are in line.
7. Install the lock pin with the threads pointing forward and the wedge groove facing the spindle pin notch. Firmly drive the lock pin into position and mount the lockwasher and nut. Tighten the nut to 50-70 N•m (37-52 ft-lb).
8. Install the spindle pin plugs into the threads at the top and bottom of the spindle. Tighten the plugs to 48-67 N•m (35-50 ft-lb).
9. Lubricate the spindle pin and bushings with C1AZ-19590-BA (ESA-M1C75-B) Long-Life Lubricant, or equivalent, through both fittings until grease is visible seeping past the upper seal at the top and from the thrust bearing slip joint at the bottom. If grease does not appear, recheck the installation procedure to correct the problem. Lack of adequate lubrication will result in rapid failure of the spindle components.
10. Install the dust shield. Refer to Section 12-24, Disc Brakes — Light and Heavy Duty — Sliding Caliper.
11. Pack the inner and outer bearing cone with bearing grease. Use a bearing packer. If a bearing packer is unavailable, pack the bearing cone by hand working the grease through the cage behind the rollers.
12. Install the inner bearing cone and seal as described in Section 11-10, Wheel Hubs and Bearings — Front (except Front Drive). Install the hub and rotor on the spindle.
13. Install the outer bearing cone, washer, and nut. Adjust bearing end play and install the nut retainer, cotter pin and dust cap as described in Section 11-10.
14. Install the caliper as described in Section 12-24, Disc Brakes — Light and Heavy Duty — Sliding Caliper.
15. Connect the steering drag link and tie rod to the steering arms. Tighten the nut to 75-105 N•m (55-77 ft-lb) and advance the nut as required for installation of the cotter pin.
16. Install the wheel and tire assembly.
17. Lower the vehicle.
18. Check and, if necessary, adjust the toe setting. Refer to Section 14-01, General Suspension Service under Adjustments. Check the brakes for proper operation.

REMOVAL AND INSTALLATION (Continued)



REMOVAL AND INSTALLATION (Continued)

Front Axle

Removal

1. Using a hoist, raise the vehicle by the frame until the weight is off the front springs with the wheels still touching the floor.
2. Remove the wheel and tire assemblies.
3. Remove the caliper assemblies from the rotors and hold them out of the way with wire. Refer to caliper removal instructions in Section 12-24, Disc Brakes — Light and Heavy Duty — Sliding Caliper.
4. Install the wheel and tire assemblies with 3 or 4 lug nuts finger tight.
5. Remove the nuts that hold the stabilizer links to the stabilizer bar. Remove the washers and insulators and disconnect the links from the bar.
6. Disconnect the steering drag link from the steering arm on the spindle using TOOL-3290-D or equivalent. Wire the steering drag link to the frame.

7. Remove the nuts from the U-bolts that hold the springs to the axle. Remove the U-bolts and stabilizer bar brackets.

8. Raise the vehicle and roll the axle out from under the vehicle.

Installation

1. Position the axle so the spring seats on the I-beam line up with the locating boss on the spring.
2. Install the U-bolts and the stabilizer bar brackets. Tighten the U-bolt nuts to 300-407 N·m (220-300 ft-lb).
3. Connect the steering drag link to the steering arm on the spindle. Install the castellated nuts and tighten to 75-105 N·m (55-77 ft-lb).
4. Position the ends of the stabilizer links onto the stabilizer bar. Install the insulators, washers and nuts and tighten to 20-34 N·m (15-25 ft-lb).
5. Install the calipers as described in Section 12-24, Disc Brakes — Light and Heavy Duty — Sliding Caliper.
6. Lower the vehicle.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Torque Range	
	N·m	Ft-Lb
Shock Absorber to Upper Shock Mount	300-407	220-300
Shock Absorber Upper Mount to Frame	300-407	220-300
Shock Absorber to Lower Mount	300-407	220-300
Leaf Spring U-Bolt Nuts	300-407	220-300
Jounce Bumpers to Frame or Bracket	40-64	30-46
Leaf Spring Front Shackle Through Bolt	200-280	148-207
Leaf Spring Rear Shackle Through Bolt	100-150	74-110
Steering Arm to Tie Rod, Castellated Nut	75-105	55-77
Steering Stop Bolt Lock Nut	50-70	37-52
Steering Drag Link to Steering Arm Castellated Nut	75-105	55-77
Steering Arm, Castellated Nut	75-105	55-77
Spindle Pin Lock Bolt, Nut	50-70	37-52
Stabilizer Bar Clamp to Frame	40-64	30-47
Stabilizer Link Through Bolt	77-110	57-81
Stabilizer Link to Stabilizer Bar, Nut	20-34	15-25

CF6454-2A

SPECIAL SERVICE TOOLS

Number	Description	Application
D79P-3283-A	Tie Rod Adjusting Tool	Universal
TOOL-3290-D	Tie Rod End Remover	Universal

CF6455-1A

SECTION 14-31 Rear Suspension — Leaf Springs

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION (CONT'D)	
Rear Suspension	14-31-1	Rear Spring	14-31-3
Rear Shock Absorber	14-31-1	Rear Stabilizer Bar	14-31-5
REMOVAL AND INSTALLATION		SPECIFICATIONS	14-31-6
Rear Shock Absorber	14-31-2		

DESCRIPTION

Rear Suspension

Semi-elliptic leaf springs are used for the rear axle suspension. The forward end of each spring is attached to a bracket on the frame side member.

Auxiliary rear springs are mounted on top of the main spring with free ends. These provide additional stability with high center of gravity loads.

Rear Shock Absorber

Shock absorbers are low pressure gas double acting type. They provide a continuous dampening effect both on compression and rebound. These shock absorbers are of telescopic design with rubber grommets at the mounting points for

quiet operation. Low pressure gas shocks are sealed and charged with nitrogen gas to reduce shock absorber trade and improve vehicle ride. The shock absorbers are sealed, non-adjustable units and must be replaced as complete assemblies.

For additional information on servicing F-Super Duty Commercial Stripped Chassis vehicle rear suspensions, refer to the following pages in Section 14-31, Rear Suspension — Leaf Springs in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Vehicle Lean 14-31-2

DIAGNOSIS AND TESTING

Rear Leaf Spring Squeak 14-31-1

REMOVAL AND INSTALLATION

Rear Shock Absorber

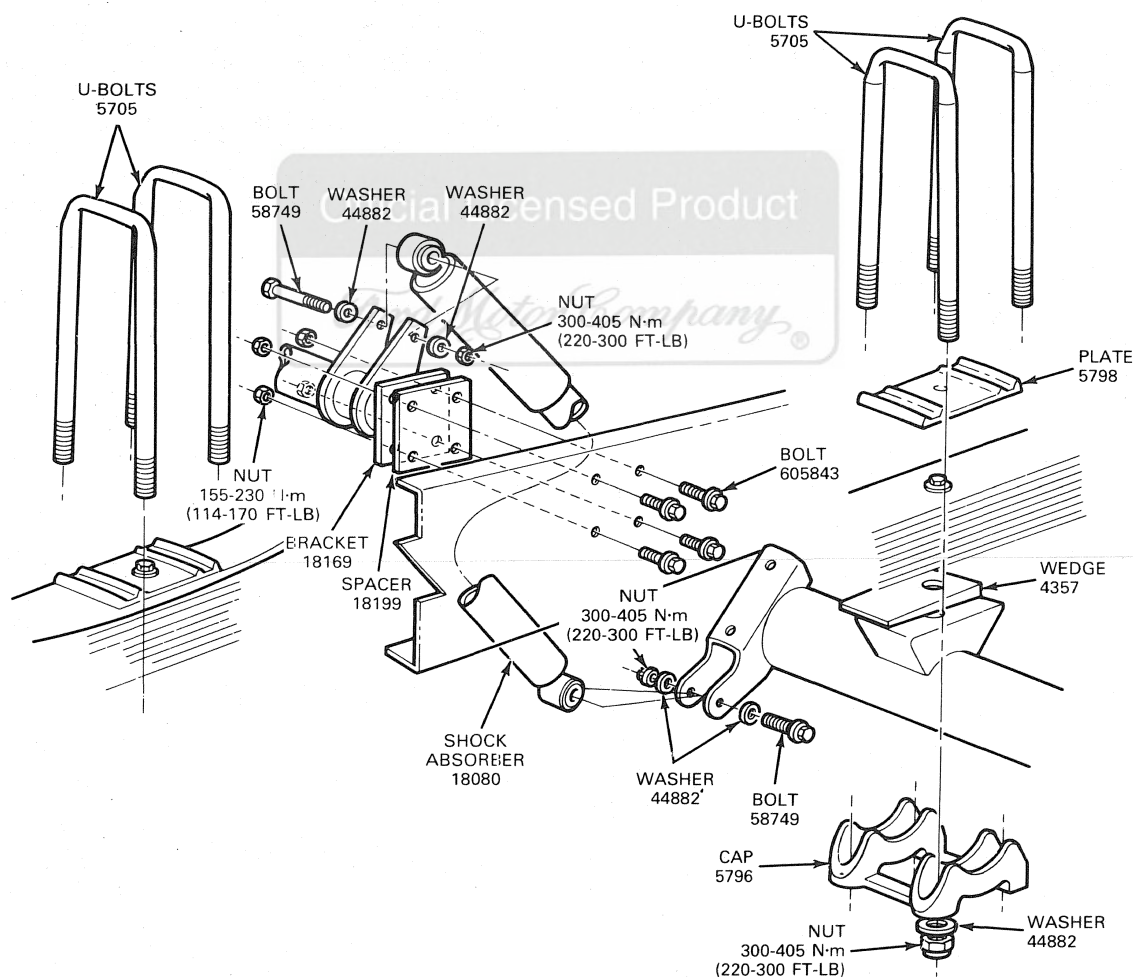
CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas to 931 kpa (135 psi). Do not attempt to open, puncture or apply heat to the shock absorbers.

Removal

1. Raise the vehicle on a hoist.
2. Remove the shock absorber lower attaching nut and bolt, and swing the lower end free of the mounting bracket on the axle housing.
3. Remove the nut and bolt from the upper shock absorber mount.

Installation

1. Position the replacement shock absorber to the upper mount and install the nut, bolt and washers.
2. Swing the lower end of the shock absorber into the mounting bracket on the axle housing. Install the mounting bolt, nut and washers. Tighten the nut to specifications listed at the end of this Section.
3. Tighten the upper nut and bolt to the specifications listed at the end of this section.



F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS — REAR SHOCK ABSORBER INSTALLATION

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REMOVAL AND INSTALLATION (Continued)**Rear Spring****Removal**

1. Raise the vehicle frame, until the weight is off the rear spring, with the tires still touching the floor.
2. Remove the nuts from the spring U-bolts and drive the U-bolts from the U-bolt plate.
3. Remove the spring-to-bracket nut and bolt at the front of the spring.
4. Remove the shackle upper and lower nuts and bolts at the rear of the spring. Remove the spring and shackle assembly from the rear shackle bracket.

Installation

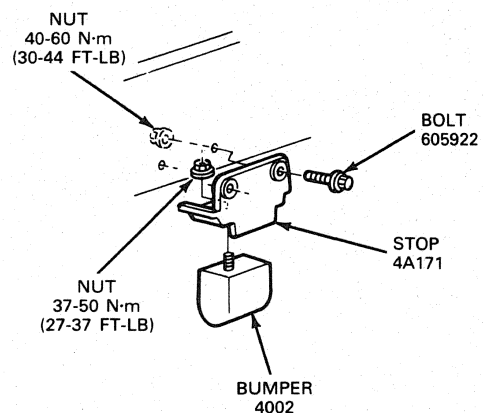
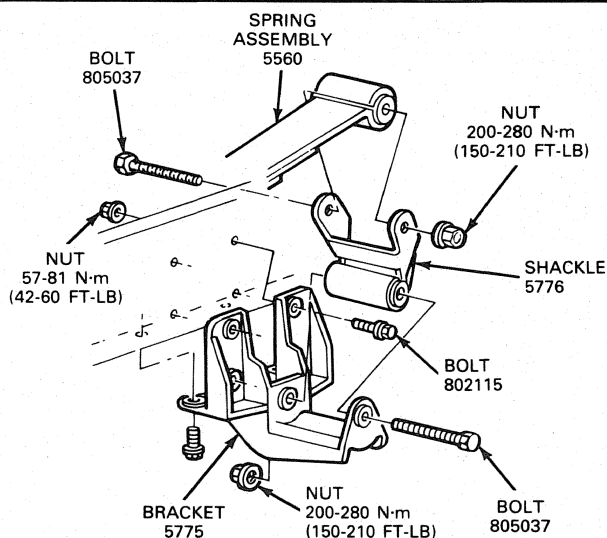
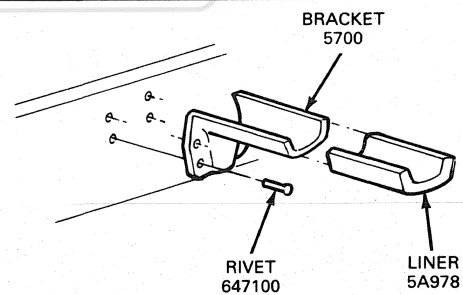
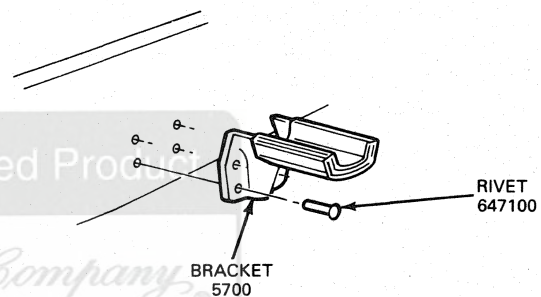
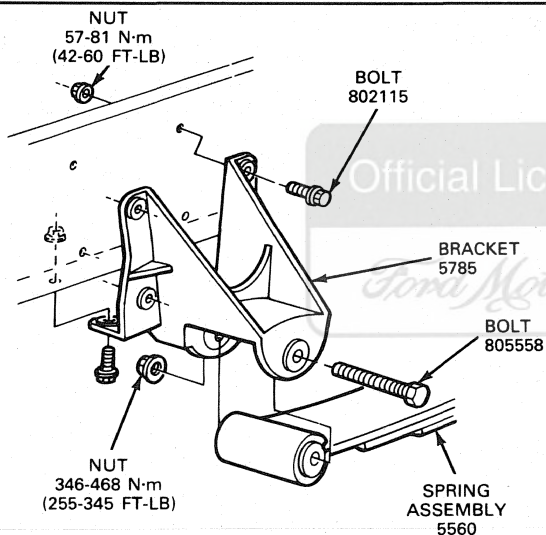
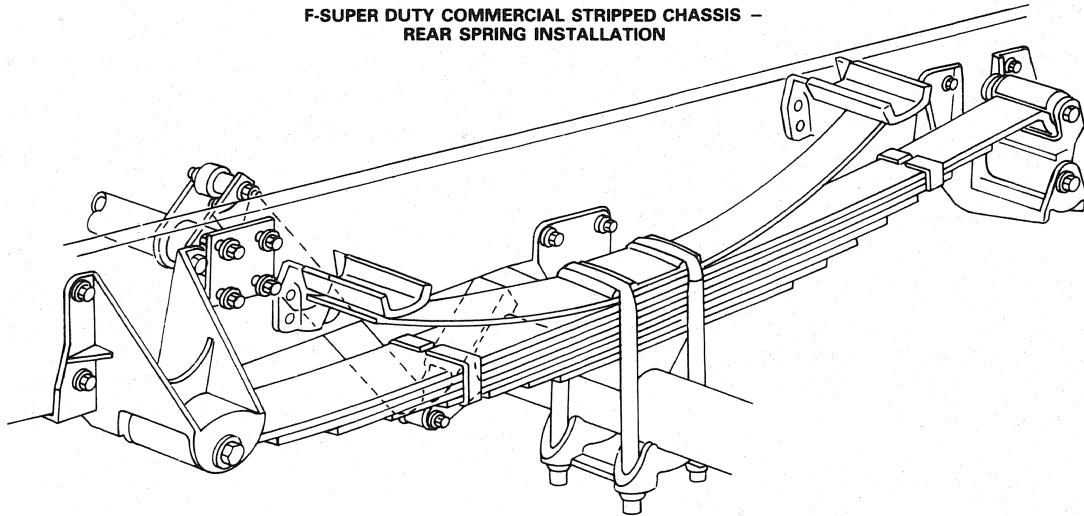
1. Position the spring in the shackle, and install the upper shackle-to-spring bolt and nut with the bolt head facing outboard.

2. Position the front end of the spring in the bracket and install the bolt and nut.
3. Position the shackle in the rear bracket and install the bolt and nut.
4. Position the spring on top of the axle with the spring tie bolt centered in the hole provided in the seat.
5. Install the spring U-bolts, U-bolt plate and nuts.
6. Lower the vehicle to the floor. Tighten the spring U-bolt nuts to specifications as listed at the end of this Section. Tighten the front spring bolt and nut and the rear shackle bolts and nuts to specifications as listed at the end of this Section.

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REMOVAL AND INSTALLATION (Continued)

F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS —
REAR SPRING INSTALLATION

F6458-2A

REMOVAL AND INSTALLATION (Continued)

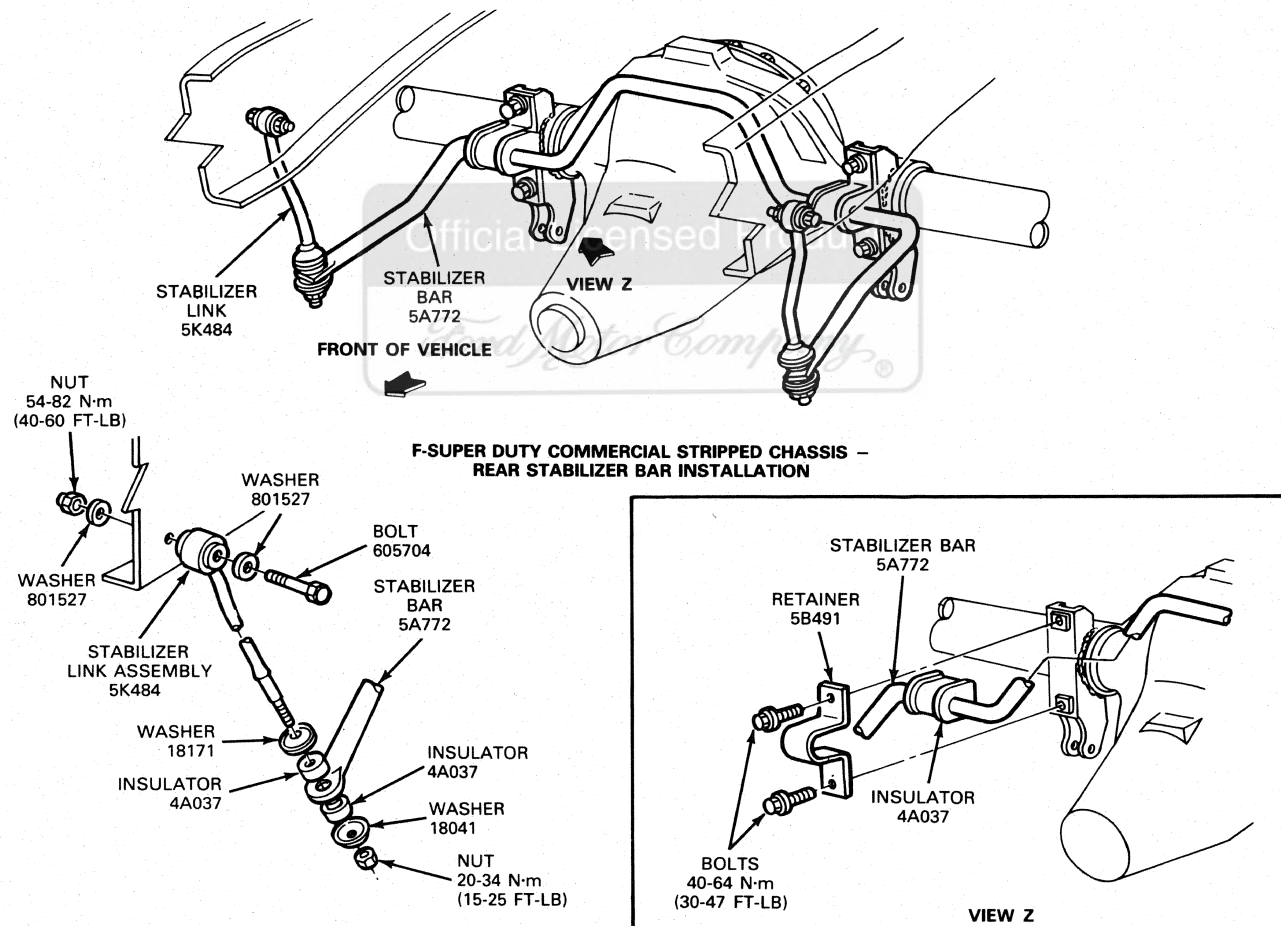
Rear Stabilizer Bar

Removal

1. Remove nut from lower end of stabilizer bar link.
2. Remove outer washer and insulator. Disconnect stabilizer bar from link.
3. Remove inner insulators and washers. Disconnect link from frame by removing nuts and bolts.
4. Remove nuts which fasten U-bolts, brackets and retainers.

Installation

1. Install outer insulator and washer on link. Install and tighten nuts to specification.
2. Position U-bolts, brackets and retainers to frame. Install and tighten nuts to specification.
3. Install inner insulator and washer on link. Connect link to stabilizer bar.
4. Install outer insulator and washer on link. Install and tighten nuts to specification.



F6459-2A

SPECIFICATIONS**TORQUE SPECIFICATIONS — F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS**

Description	Torque Range	
	N·m	Ft-Lb
Jounce Bumper to Frame Nut	37-50	27-37
Leaf Spring to Axle U-Bolt Nut	300-405	220-300
Leaf Spring to Front Bracket Nut and Bolt	346-468	255-345
Leaf Spring to Rear Shackle Nut and Bolt	200-280	150-210
Rear Shackle to Frame Mounted Bracket Nut and Bolt	200-280	150-210
Shock Absorber (Lower Mount) to Axle Nut and Bolt	300-405	220-300
Shock Absorber (Upper Mount) to Bracket Nut and Bolt	300-405	220-300
Shock Absorber Upper Bracket to Frame Nuts and Bolts	155-230	114-170
Stabilizer Bar to Axle Bolt	40-64	30-47
Stabilizer Link to Frame Nut and Bolt	54-82	40-60
Stabilizer Link to Stabilizer Bar Nut	20-34	15-25

CF6460-2A

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SECTION 15-01 General Driving Axle Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	15-01-1	SPECIFICATIONS	15-01-1

DESCRIPTION

F-Super Duty Commercial Stripped Chassis vehicles are equipped with a Dana 80 rear axle. For general information regarding Dana rear axles refer to the following pages in Section 15-01, General Driving Axle Service, in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Axle Adjustments	15-01-4
Rear Axle Companion Flange Runout Check	15-01-9
Rear Axle Lubrication	15-01-4
Rear Wheel Bearing and Seal Removal and Installation	15-01-4

Ring Gear Replacement	15-01-4
Shim Selection	15-01-4

CLEANING AND INSPECTION

Inspection After Carrier Disassembly	15-01-12
Inspection Before Carrier Disassembly	15-01-11

DIAGNOSIS AND TESTING

Axle Testing	15-01-2
Diagnosis Guides	15-01-4
Noise Acceptability	15-01-2
Total Axle Backlash Check	15-01-3

SPECIFICATIONS

REAR AXLE LUBRICANT CAPACITIES

Approximate Capacity		
U.S. Pints	Imperial Pints	Liters
8.25	6.9	3.9

CE8075-1A

RING GEAR TORQUE SPECIFICATIONS

N-m	Ft-Lb
285-311	210-230

CE8076-1A

SPECIAL SERVICE TOOLS

Number	Description	Application
TOOL-4201-C	Dial Indicator with Bracketry	Axle Adjustments
D78P-4201-B	Dial Indicator — Magnetic Base	Axle Adjustments
T57T-4851-B	Pinion Flange Holding Tool	Axle Adjustments
TOOL-6565-AB	Cup Shaped Adapter	U-Joint Checking
TOOL-6565-AC	Cup Shaped Adapter	U-Joint Checking
T78P-4851-A	Pinion Flange Holding Tool	Axle Checking

CE7669-2A

SECTION 15-05 Integral Carrier Rear Axle — Dana

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	15-05-1	SPECIFICATIONS	15-05-1

DESCRIPTION

F-Super Duty Commercial Stripped Chassis vehicles are equipped with a Dana 80 rear axle. For axle service on these vehicles, refer to the following pages in Section 15-05, Integral Carrier Rear Axle — Dana, in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS 15-05-6

ASSEMBLY

Assembly of Differential into

Housing 15-05-31

Depth Gauge Check 15-05-27

Differential Case 15-05-23

Final Assembly — Differential

into Housing — Model 80 15-05-35

Pinion Bearing Cup

Installation 15-05-27

Ring Gear and Pinion Backlash

Model 80 15-05-33

CLEANING AND INSPECTION

Inspection Before Disassembly ... 15-05-22

DIAGNOSIS AND TESTING 15-05-6

DISASSEMBLY 15-05-14

REMOVAL AND INSTALLATION

Drive Pinion Oil Seal 15-05-6

Rear Axle 15-05-9

Rear Axle Shaft 15-05-13

Seals and Bearings 15-05-14

SPECIFICATIONS

DANA — 80 AXLE REFILL CAPACITIES

Ford Lube Specification	Approximate Capacities		
	U.S. Pints	Imp. Pints	Liters
ESW-M2C105-A (E0AZ-19580-AA)	8.5	6.8	4.0

CE8019-2A

DANA AXLE ADJUSTMENTS

Description	Specification	Description	Specification
Backlash Between Ring Gear and Pinion	0.13-0.20 mm (0.005-0.008 inch)	Pinion Bearing Preload (with new bearings)	2.26-4.53 N•m (20-40 in-lbs)
Backlash Maximum Variation Between Teeth	0.05 mm (0.002 inch)		

CE7675-2A

SECTION 15-60 General Driveshaft Service

SUBJECT **PAGE**
DESCRIPTION 15-60-1

SUBJECT **PAGE**

DESCRIPTION

F-Super Duty Commercial Stripped Chassis vehicles are equipped with two-piece driveshafts and a center support bearing. For general driveshaft service refer to the following pages in Section 15-60, General Driveshaft Service, in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Alternate In-Vehicle
 Driveshaft Balancing 15-60-16
 Driveshaft Balancing 15-60-14

DIAGNOSIS AND TESTING

Coupling Shaft/Center Bearing
 Alignment 15-60-10
 Diagnosis Guides 15-60-13
 Driveline Angularity 15-60-6
 Driveline Vibration 15-60-3
 Rear Axle Companion Flange
 Runout Check 15-60-11
 Slip Yoke Spline 15-60-11
 Two-Piece Driveshaft Service 15-60-10
 U-Joint Phasing 15-60-5

SPECIFICATIONS

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DRIVESHAFT ANGLE TO HORIZONTAL — (CURB LOAD EMPTY)

Restrictions	Wheelbase		Driveline	Spring Rating at Pad (lbs.)	Transmission M5HD	Empty Rear Ride Height Axle to Frame	
	mm	inch				mm	inch
Without Auxiliary Spring	4013	158	Two Piece	4900	8-1/4°	260	10.25
With Auxiliary Spring	4013	158	Two Piece	4900	9°	304	11.98

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COUPLING SHAFT ANGLE TO HORIZONTAL

Restrictions	Wheelbase		Transmission M5HD
	mm	inch	
Without Auxiliary Spring	4013	158	6°
With Auxiliary Spring	4013	158	4-1/2°

CE8078-1A

REAR AXLE PINION ANGLE TO HORIZONTAL

Restrictions	Wheelbase		Spring Capacity at Pad		Spring Part Number (5560)	Curb Load Empty	
	mm	Inch	Lbs.	Kg		Ratio	Angle
Without Auxiliary Spring	4013	158	4900	2223	E9TD-BD	All	5-1/2°
With Auxiliary Spring	4013	158	4900	2223	E9TD-CA	All	5-1/2°

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ENGINE ANGLE TO HORIZONTAL

Wheelbase		Engine	Transmission	Angle
mm	Inch			
4013	158	7.3L	M5HD	5-1/2°

CE8080-1A

SECTION 15-61 Driveshaft — Single Type U-Joint

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		LUBRICATION	
Driveshaft Runout and Balance	15-61-2	U-Joints	15-61-2
Driveshaft Alignment	15-61-2	Slip Yoke	15-61-2
Adjustable Driveline		REMOVAL AND INSTALLATION	
Support Plate	15-61-3	Driveshaft	15-61-4
DESCRIPTION	15-61-1	SPECIFICATIONS	15-61-6
DIAGNOSIS AND TESTING	15-61-1		
DISASSEMBLY AND ASSEMBLY			
Snap Ring Type U-Joint	15-61-5		

DESCRIPTION

The driveshaft or coupling shaft is composed of the universal joints (U-joints), connecting shafts and the attaching flanges. The number of shafts and U-joints used depends on the vehicle wheelbase.

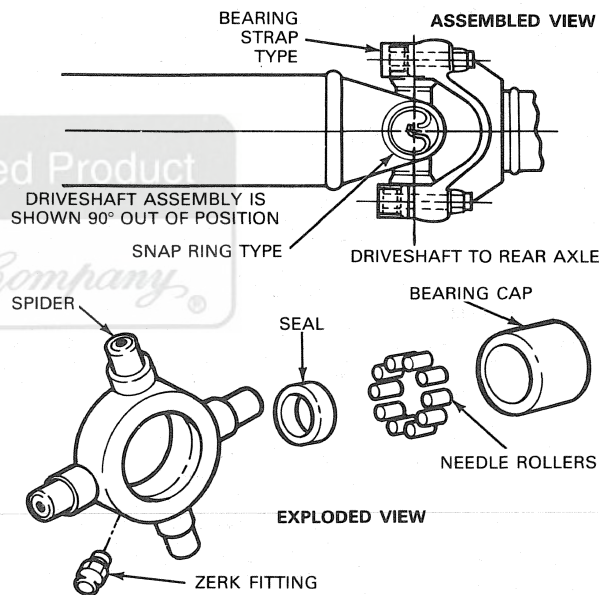
All the vehicle U-joint spiders and sliding splines are equipped with lubrication fittings. They should be lubricated periodically with High Temperature Grease, NLGI No. 2, ESL-M1C173-A or equivalent.

The majority of vehicles are equipped with center support bearings that are pre-lubricated and sealed for the life of the bearing.

Vehicles may have any or all of the following types of driveshafts:

- **Driveshaft** — The shaft which accommodates the change in length (slip) in the driveline system. The driveshaft is the shaft which is the input to a single axle or the forward rear axle of a tandem drive unit.
- **Couplingshaft** — All shafts which connect the transmission to the driveshaft. Couplingshafts are attached to a support plate via a shaft support bearing.

NOTE: All driveline shafts are balanced; therefore, if a vehicle is to be undercoated, cover all shafts to prevent getting undercoating material on the shafts.



E4345-1C

All U-joints are of the needle bearing type. The U-joints are held in place with snap rings or bearing straps.

DIAGNOSIS AND TESTING

Refer to Section 15-60, General Driveshaft Service and Section 18-01 Noise, Vibration and

Harshness — Diagnosis in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A).

LUBRICATION

U-Joints

Use High Temperature Grease, NLGI No. 2, ESL-M1C173-A, or equivalent. Apply lubricant through the zerk fitting until fresh grease purges at each of the four seals.

Slip Yoke

Use High Temperature Grease, NLGI No. 2, ESL-M1C173-A, or equivalent. Apply lubricant through the zerk fitting until fresh grease purges at the vent hole in the welsh plug. Then, apply finger over vent hole in the welsh plug and apply lubricant until it purges at the seal at rear of the slip yoke.

ADJUSTMENTS

Driveshaft Runout and Balance

Refer to Section 15-60, General Driveshaft Service, in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A).

Driveshaft Alignment

Before adjusting components for correct driveshaft alignment, be sure to check the following:

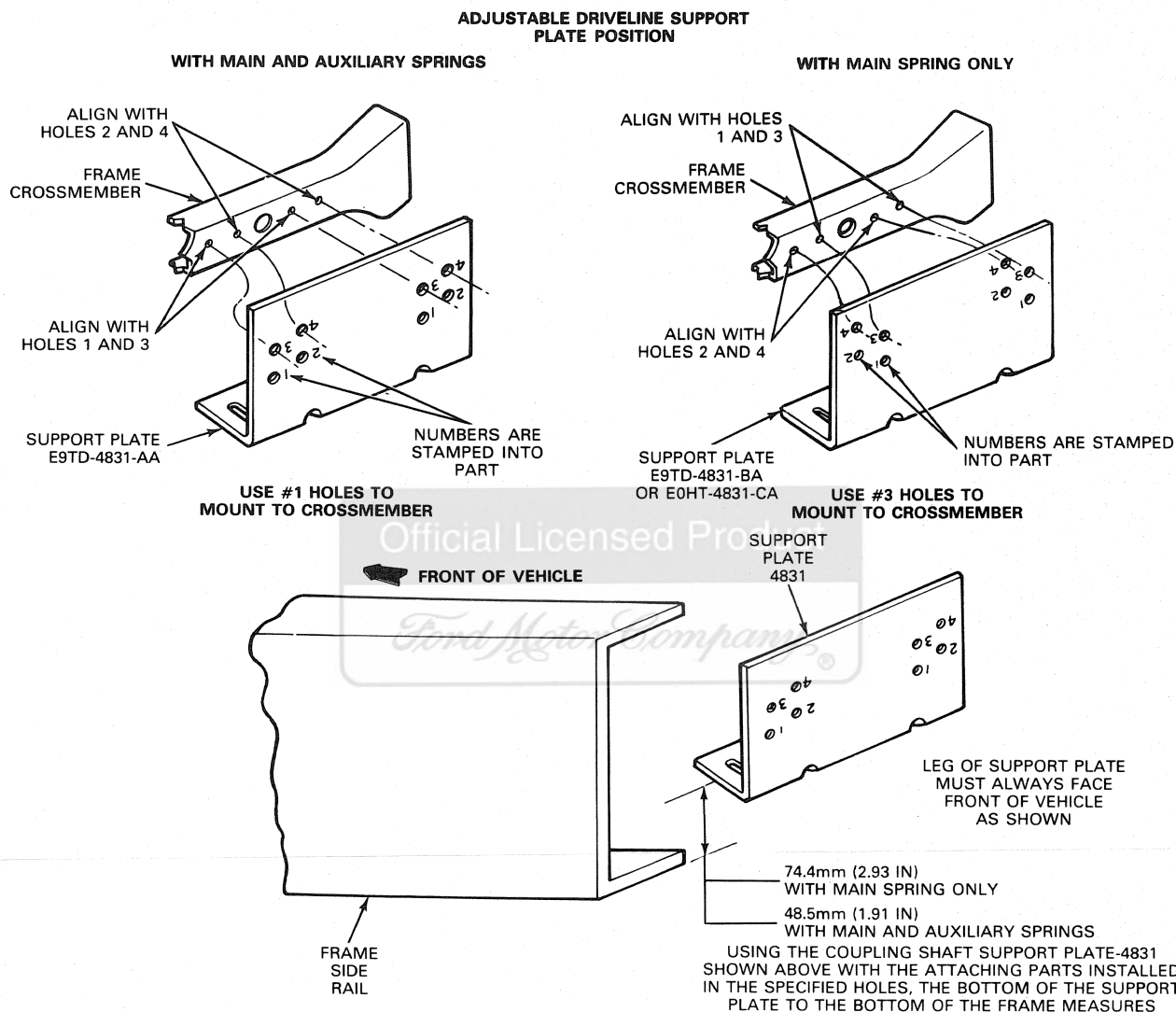
1. Alignment of drivelines must be accomplished with the empty vehicle sitting on a hard level surface.
2. All angle measurements must be made on a surface of the component which is either parallel to or perpendicular to the centerline of the component being measured.
3. Angle measurements must be made with either a spirit level or an inclinometer. Angle values given in Section 15-60 are nominal values with a tolerance of $\pm 1/4^\circ$.

ADJUSTMENTS (Continued)

Adjustable Driveline Support Plate

An adjustable driveline support plate is used. Although it can be mounted in any one of sever-

al positions, only one position is correct for a specific application. The correct position can be determined from the following illustration.



E8093-2A

REMOVAL AND INSTALLATION

Driveshaft

Removal

1. Disconnect the driveshaft from the yoke at the rear axle.
2. Slide the driveshaft off the coupling shaft splines.
3. Working from the center support nearest to the rear of the vehicle, remove the two attaching bolts and support the bearing.
4. Remove the forward joint from its mating yoke.
5. Repeat steps 3 and 4 until last shaft has been removed.
6. Thoroughly clean old grease and dirt from the driveshaft splines and then check the splines for wear, warpage, and cracks. If the shaft is worn, warped, or cracked, replace it.

Using a suitable cleaning fluid, clean all dirt from the slip yoke, slip yoke splines, and shaft splines.

Do not clean the plastic coating on the male splines with a wire brush. Do not remove the plastic coating from the male splines.

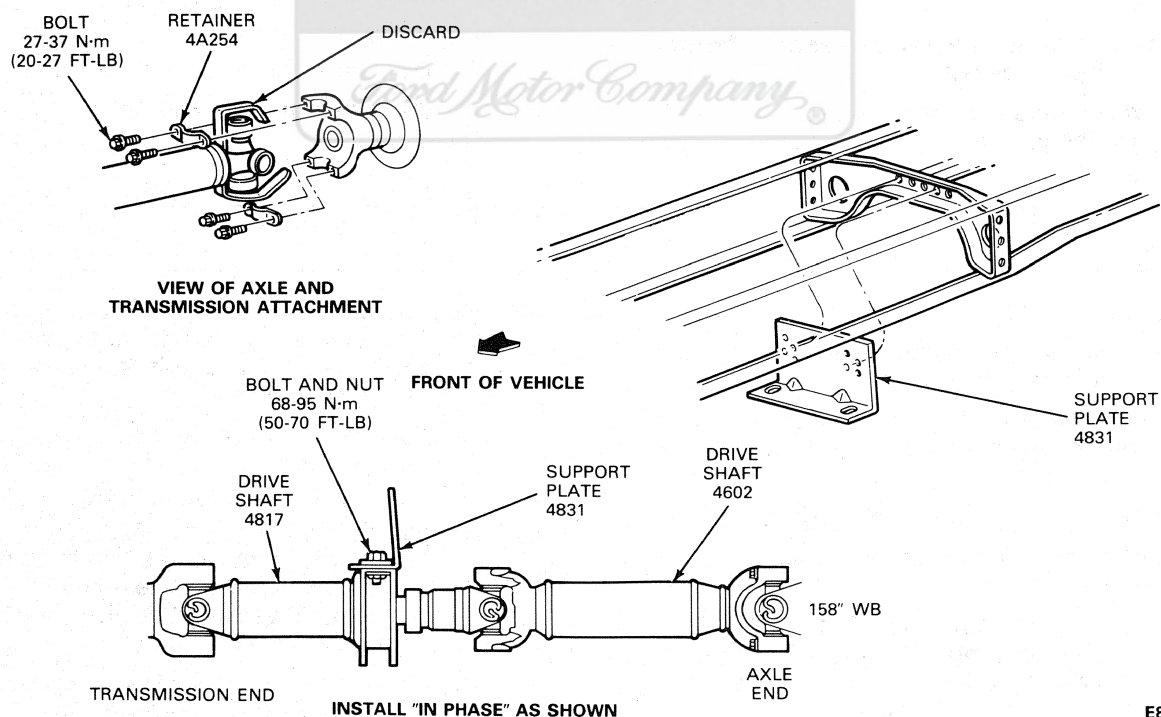
Carefully inspect the slip yoke splines for wear or evidence of twisting. Check the clearance between the slip yoke splines and the shaft splines.

Wash all parts except the sealed ball bearing and rubber cushion in suitable cleaning fluid. **Do not immerse the sealed bearing in cleaning fluid.** Wipe the bearing and cushion clean with a cloth dampened with cleaning fluid.

Check the bearing for wear or rough action by rotating the inner race while holding the outer race. If wear or roughness is evident, replace the bearing.

Examine the rubber cushion for evidence of hardening, cracking, or deterioration. Replace it if it is damaged in any way.

Grease retainers and slingers are serviced only as part of the bearing assembly.



E8081-2A

REMOVAL AND INSTALLATION (Continued)

Installation

1. Connect the front joint of the coupling shaft to the yoke on the transmission. Tighten the bolts to specification found at the end of this Section.
2. Secure the center bearing to the frame bracket with the center support and attaching bolts. Tighten the bolts to specification found at the end of this Section. Make sure that the center bearing is not twisted in the support plate.
3. If working on a vehicle with more than one coupling shaft, connect the rear shaft to the forward one, then install the remaining center support. All splines should be lubricated with High Temperature Grease, NLGI No. 2, ESL-M1C173-A or equivalent.
4. Connect the rear U-joint to the rear axle flange and tighten the bolts to specification. Be sure all driveshaft and coupling shaft yokes are properly in phase.

DISASSEMBLY AND ASSEMBLY

Snap Ring Type U-Joint

Disassembly

1. Place the driveshaft on a suitable workbench, being careful not to damage the tube.

CAUTION: Under no circumstances is the driveshaft assembly to be clamped in the jaws of a vise or similar holding fixture. Denting or localized fracture of the tube may result, which could cause driveshaft failure during vehicle operation.

2. Remove the snap rings that retain the bearings in the yoke and in the driveshaft or coupling shaft.

3. Position the U-joint Tool, T74P-4635-C or equivalent on the shaft and press the bearing out of the yoke. If the bearing cannot be pressed all the way out of the flange, remove it with vise grip or channel lock pliers. Mark the yoke and the shaft to be sure that they will be reassembled in the same relative position.
4. Re-position the tool to press on the spider in order to remove the bearing from the opposite side of the flange.
5. Remove the flange from the spider.
6. Remove the bearings and spider from the driveshaft or coupling shaft in the same manner.

Assembly

1. Start a new bearing into the yoke at the rear of the driveshaft.
2. Position the spider in the rear yoke and press the bearing 6.35mm (1/4 inch) below the surface.
3. Remove the tool and install a new snap ring.
4. Start a new bearing into the opposite side of the yoke.
5. Install the U-Joint Tool T74P-4635-C or equivalent, and press on the bearing until the opposite bearing contacts the snap ring.
6. Remove the tool and install a new snap ring.
7. Re-position the driveshaft or coupling shaft and install the new spider and two new bearings in the front yoke in the same manner as the rear yoke.
8. Position the flange on the spider and install two new bearings and snap rings.
9. Check the joint for freedom of movement. If a bind has resulted from misalignment during the foregoing procedures, tap the ears of the driveshaft sharply to relieve the bind. Do not install the driveshaft if the U-joints show any signs of binding.

NOTE: The effort required for U-joint movement should not exceed 35 in-lbs when measured with a spring scale.

SPECIFICATIONS**DRIVESHAFT — TORQUE LIMITS**

Description	Bolt Size	Torque	
		N•m	Ft-Lb
Bolt — U-Joint and Strap to Rear Yoke.	5/16 — 24	20-27	15-20
Bolt — U-Joint and Strap to Front Yoke.	5/16 — 24	20-27	15-20
Bolt and Nut — Coupling Shaft Center Bearing to Support Plate.	7/16 — 14	68-95	50-70
Bolt and Nut — Support Plate to Frame Crossmember	M10 — 1.50	40-64	30-46

CE8082-2A

SPECIAL SERVICE TOOLS

Tool Number	Description
T74P-4635-C	U-Joint Bearing Remover and Installer

CE3681-1C

Official Licensed Product

Ford Motor Company®

SECTION 16-01 General Clutch Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	16-01-1	SPECIFICATIONS	16-01-1

DESCRIPTION

For clutch service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 16-01, General Clutch Service in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Dowel Replacement Procedure 16-01-3

CLEANING AND INSPECTION

Clutch Disc 16-01-5
Clutch Release Bearing 16-01-5

Crankshaft End Play 16-01-8
Crankshaft End Play Check 16-01-5
Flywheel Face Runout 16-01-8
Flywheel Runout 16-01-5
Pilot Bearing Assembly 16-01-8
Pressure Plate and Cover 16-01-5

DIAGNOSIS AND TESTING

Diagnosis Guides 16-01-1
Testing Procedures 16-01-1

SPECIFICATIONS

Official Licensed Product

SPECIAL SERVICE TOOLS

Number	Description	Application
T50T-100-A	Impact Slide Hammer — 2-1/2 Lbs.	Universal
T59L-100-A	Impact Slide Hammer — 2-1/2 Lbs.	Universal
D79P-100-A	Impact Slide Hammer — 5 Lbs.	Universal
T58L-101-A	Puller Attachment	Universal — Use with Slide Hammer
T57L-500-B	Bench-Mounted Holding Fixture	Universal
D78P-4201-B	Dial Indicator with Magnetic Base	Universal
TOOL-4201-C	Dial Indicator with Bracketry	Universal
D79T-7550-A	Clutch Alignment Shaft	10 Spline — 1-1/2 Inch Outside Diameter
D79T-7550-B	Clutch Alignment Shaft	10 Spline — 1-3/4 Inch Outside Diameter
D79T-7550-C	Clutch Alignment Shaft	10 Spline — 2 Inch Outside Diameter

CC4852-2B

SECTION 16-02 Clutch

SUBJECT **PAGE**
DESCRIPTION **16-02-1**

SUBJECT **PAGE**
SPECIFICATIONS **16-02-1**

DESCRIPTION

For information on clutch service for F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 16-02, Clutch in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

DESCRIPTION AND OPERATION 16-02-1
DIAGNOSIS AND TESTING 16-02-1
REMOVAL AND INSTALLATION 16-02-1
 Clutch Pilot Bearing 16-02-1
 Clutch Release Lever – 7.3L
 Diesel 16-02-2
 Single Disc Type Clutch 16-02-2

SPECIFICATIONS

SPECIAL SERVICE TOOLS

Number	Description	Application
T50T-100-A	Impact Slide Hammer — 2-1/2 Lbs.	Universal
T59L-100-B	Impact Slide Hammer — 2-1/2 Lbs.	Universal
D79P-100-A	Impact Slide Hammer — 5 Lbs.	Universal
T58L-101-B	Puller	Universal
T57L-500-B	Bench Mounted Holding Fixture	Universal
T00L-1175-AC	Seal Remover	Universal — Use with Slide Hammer
T75L-4201-A	Clutch Housing Alignment Adapter	Universal — For Right Angle Measurements
T75L-4201-B	Clutch Housing Alignment Adapter	Universal
D78P-4201-B	Dial Indicator with Base	Universal
T00L-4201-C	Dial Indicator with Bracketry	Universal
T75L-6392-A	Clutch Housing Alignment Tool	Use with Clutch Housing Alignment Adapters and Dial Indicator
D79L-7000-A	Retaining Ring Pliers	Universal
T74P-7137-A	Pilot Bearing Replacer	Use with Clutch Aligner
T71P-7137-H	Clutch Aligner	Universal
D79T-7550-A	Clutch Alignment Shaft	1-1/2 Inch Outside Diameter — 10 Spline
D79T-7550-B	Clutch Alignment Shaft	1-3/4 Inch Outside Diameter — 10 Spline

CC4017-2D

SECTION 16-04 Hydraulic Clutch System

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	16-04-1	REMOVAL AND INSTALLATION	
		Clutch Hydraulic System	16-04-1
		Clutch Pedal	16-04-2

DESCRIPTION

For hydraulic clutch system service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 16-04, Hydraulic Clutch Service in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Clutch/Starter Interlock Switch	16-04-2
Hydraulic Clutch — Master Cylinder Pushrod	16-04-2

DESCRIPTION AND OPERATION

Clutch Interlock Three Function Switch — F-Series	16-04-1
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DIAGNOSIS AND TESTING

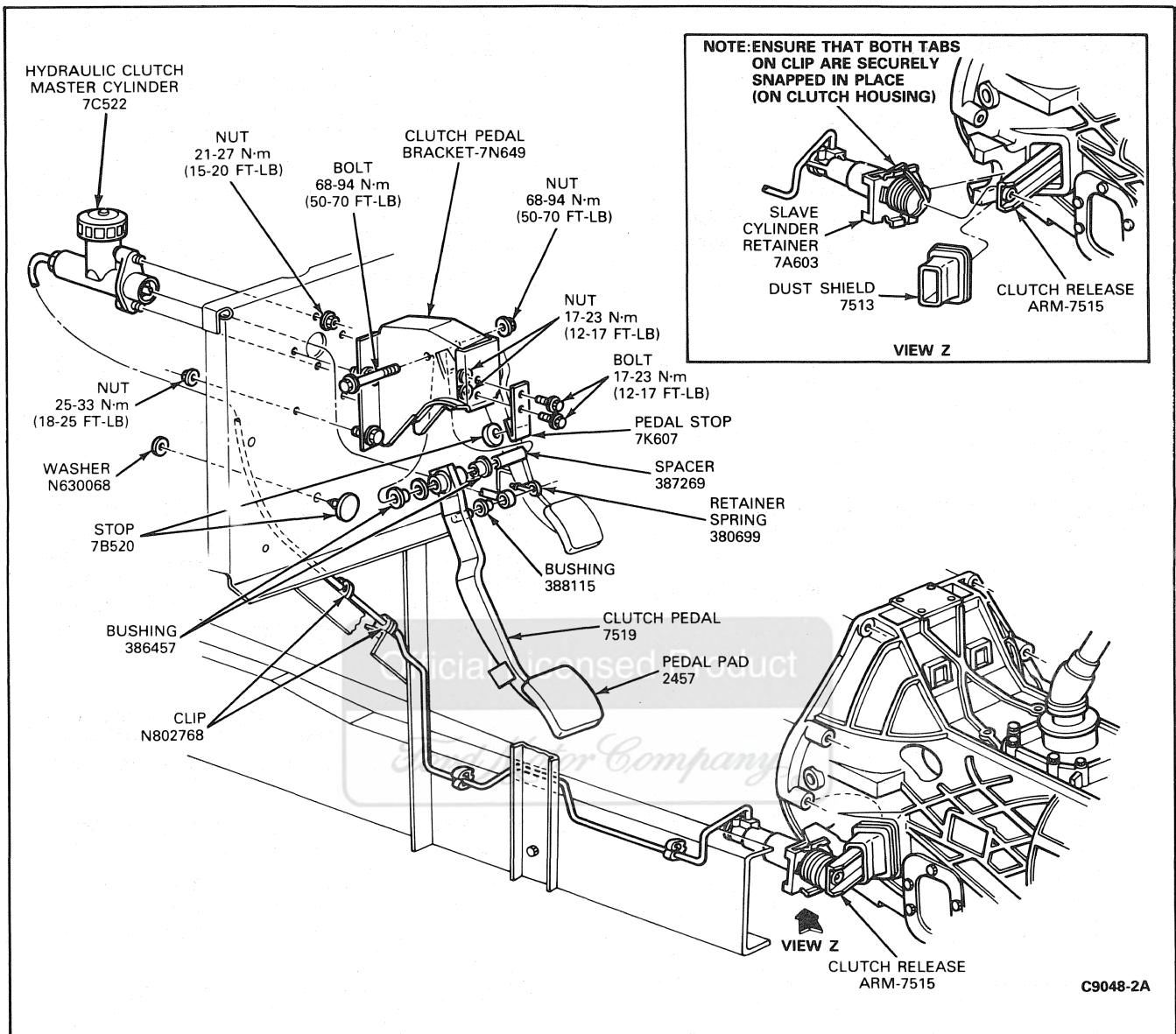
Clutch/Starter Interlock Switch	16-04-2
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REMOVAL AND INSTALLATION

Bleed Procedure for External Slave Cylinder	16-04-7
Clutch Interlock Three Function Switch	16-04-7
Clutch Release Bearing	16-04-8
Clutch Slave Cylinder	16-04-8
Cross Shaft Lever	16-04-4
Hydraulic Clutch Line	16-04-7

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REMOVAL AND INSTALLATION



REMOVAL AND INSTALLATION (Continued)**Clutch Hydraulic System**

NOTE: For vehicles equipped with external slave cylinders, prior to any vehicle service that requires removal of the slave cylinder, (i.e.; transmission removal), the master cylinder push rod must be disconnected from the clutch pedal. If not disconnected, permanent damage to the slave cylinder will occur if the clutch pedal is depressed while the slave cylinder is disconnected.

Removal

1. From the inside of the cab, carefully pry the pushrod and retainer bushing from the cross-shaft lever pin.
2. Disconnect the interlock switch connector plug.
3. Remove the two nuts retaining the clutch reservoir and master cylinder assembly to the firewall.
4. From the engine compartment, first note the clutch tube routing to the slave cylinder, then remove attaching hardware for the hydraulic tube retaining clips.
5. From the engine compartment, remove the clutch reservoir and master cylinder assembly from the firewall. On F-Series and Bronco, when the master cylinder studs are free of the dash panel, rotate the cylinder 105 degrees counter-clockwise to permit the interlock switch to exit the dash panel.
6. On F-Super Duty Commercial Stripped Chassis vehicles, use a screwdriver or a similar tool and lift the two retaining tabs of the slave cylinder retaining bracket. Disengage the tabs from the bell housing lugs and then slide outward to remove.
7. Remove the clutch hydraulic system from the vehicle.

Installation

1. Position the clutch fluid reservoir and master cylinder assembly into the firewall. From inside the cab install the two nuts and tighten.
2. Correctly route the hydraulic tubing and slave cylinder to the transmission bell housing.

NOTE: Care must be taken during routing of the nylon line to keep away from engine exhaust system components.

3. Reinstall the clutch tube retaining clips.
4. On F-Super Duty Commercial Stripped Chassis vehicles install the slave cylinder by pushing the slave cylinder push rod into the release lever and slide the slave cylinder into the bell housing lugs.

NOTE: When installing a new hydraulic system, the external slave cylinder (7.3L diesel and 7.5L gas) contains a shipping strap that pre-positions the push rod for installation and also provides a bearing insert. Following installation of the new slave cylinder, the first actuation of the clutch pedal will break the shipping strap and give normal system operation.

5. From inside the cab, press the pushrod with the retainer bushing onto the cross-shaft lever pin until the bushing tabs snap into position in the groove.

The flanged side of the bushing must be towards the cross-shaft lever.

6. Check the clutch reservoir and add fluid if required. Depress the clutch pedal at least ten times to verify smooth operation and proper release.

NOTE: The proper fluid level is indicated by a step on the reservoir. Do not overfill. The upper portion of the reservoir must accept fluid that is displaced from the slave cylinder as the clutch wears.

Clutch Pedal**Removal**

1. Disconnect the clutch master cylinder push rod from the clutch pedal.
2. Remove the through bolt and nut from the clutch pedal bracket.
3. Remove the clutch pedal with all the bushings, washer and the spacer.

Installation

1. Position the clutch pedal into the clutch pedal bracket with the bushings, washer and spacer.
2. Install the through bolt and nut. Tighten the nut to 68-94 N·m (50-70 ft-lb).
3. Install the clutch master cylinder push rod on the pedal, and install the retaining spring.

SECTION 16-10 General Manual Transmission Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	16-10-1	SPECIFICATIONS	16-10-1

DESCRIPTION

For manual transmission service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 16-10, General Manual Transmission Service in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

CLEANING AND INSPECTION

Flywheel Clutch Face Runout	16-10-4
Sub-Assemblies	16-10-2
Bearings	16-10-3
Gear Shift Housing	16-10-2
Gears	16-10-3

Input Shaft	16-10-4
Output Shaft	16-10-4
Reverse Idler Gear	16-10-4
Seals and Gaskets	16-10-4
Synchronizer Blocker Rings	16-10-4
Thrust Washers and Bearing Covers	16-10-4
Transmission Case	16-10-2
Transmission	16-10-1

DIAGNOSIS

Diagnosis Guides	16-10-1
------------------------	---------

SPECIFICATIONS

ZF M50D-HD LUBRICANT CAPACITY

Approximate Refill Capacity	
U.S. Pints	Liters
6.8	3.2

Fill to bottom of filler hole with ESP-M2C166-H (Motorcraft Mercon)

CC9049-1A

SPECIAL SERVICE TOOLS

Number	Description	Application
D78P-4201-B	Dial Indicator with Magnetic Base	Universal
TOOL-4201-C, D78P-4201, F, G	Dial Indicator with Bracketry	Universal

CC4860-2C

SECTION 16-34 Model S5-42 ZF Manual Transmission

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	16-34-1	SPECIFICATIONS	16-34-4
REMOVAL AND INSTALLATION			
Transmission	16-34-1		
Crossmember	16-34-3		

DESCRIPTION

For transmission service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 16-34, Model S5-42 ZF Manual Transmission in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

ADJUSTMENTS

Tapered Roller Bearing Preload
Measurement and Adjustment ... 16-34-24

DIAGNOSIS AND TESTING 16-34-3

DISASSEMBLY AND ASSEMBLY

Transmission 16-34-9

INSPECTION

Synchronizer Ring/Synchronizer
Body Wear Check 16-34-26

REMOVAL AND INSTALLATION

Rear Oil Seal - 4x4 and
F-Super Duty Transmissions 16-34-7
Transmission

SPECIFICATIONS 16-34-53

SUBASSEMBLIES

Countershaft 16-34-53
Input Shaft 16-34-52
Mainshaft 16-34-36
Shift Rails 16-34-29
Shift Tower Assembly 16-34-27
Transmission Front Case 16-34-31
Transmission Rear Case 16-34-30

REMOVAL AND INSTALLATION

Transmission

Removal

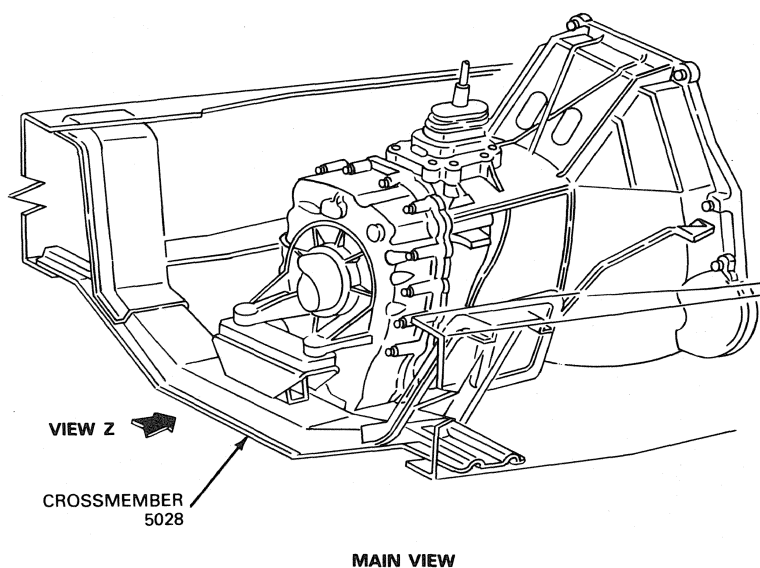
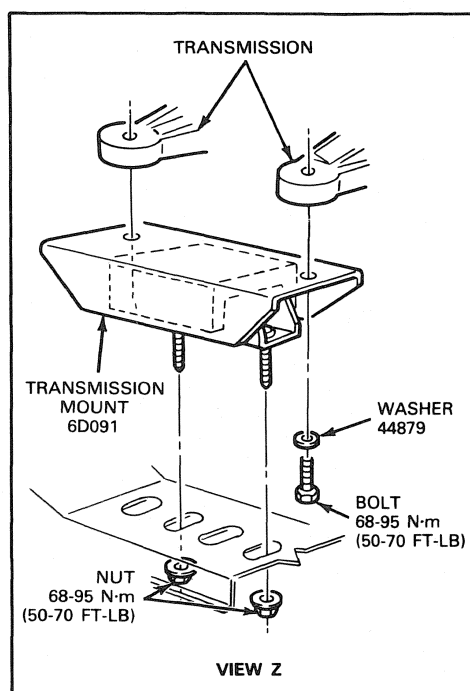
1. Shift the transmission into neutral.
2. Remove the ball from the upper shift lever.
3. Remove the four screws and remove the boot and bezel assembly from the transmission opening cover.
4. Remove the two bolts and remove the upper shift lever from the lower shift lever.
5. Raise the vehicle on a hoist and position safety stands under the vehicle.
6. Disconnect the speedometer cable.

REMOVAL AND INSTALLATION (Continued)

7. Disconnect the back-up lamp switch located at the top left hand side of the transmission.
8. Remove the drain plug and drain the oil from the transmission.
9. Position a transmission jack, such as Rotunda Transmission Jack 077-00008 or equivalent under the transmission.
10. Disconnect the driveshaft and clutch linkage from the transmission and wire it to one side. Refer to Section 15-62, Driveshafts and Section 16-04, Hydraulic Clutch System for detailed procedures.
11. Remove the transmission parking brake from the transmission. Refer to Section 12-70, Parking Brake Cable Actuated, Transmission Mounted, for procedure.
12. Remove the transmission rear insulator and lower retainer. Remove the crossmember as described in Crossmember removal and installation in this Section.
13. Remove the bolts that retain the transmission to the engine block.
14. Move the transmission to the rear until the input shaft clears the engine flywheel. Lower the transmission from the vehicle.

Installation

1. Place the transmission on a transmission jack such as Rotunda Transmission Jack 077-00008 or equivalent. Install guide studs in the front case and raise the transmission until the input shaft splines are aligned with the clutch disc splines. The clutch release bearing and hub must be properly positioned in the release lever fork.
2. Slide the transmission forward on the guide studs until it is in position on the front case. Install the attaching bolts and tighten them to 54-67 N·m (40-50 ft-lb). Remove the guide studs and install the two remaining attaching bolts.
3. Install the crossmember as described under Crossmember Removal and Installation in this Section. Position the insulator and retainer between the transmission and crossmember. Install bolts and tighten to 60-80 N·m (45-60 ft-lb). Install the nut retaining the insulator and retainer to crossmember. Tighten to 68-94 N·m (50-70 ft-lb). Remove the transmission jack.
4. Connect the speedometer cable and driven gear and clutch linkage.



REMOVAL AND INSTALLATION (Continued)

5. Connect the backup lamp switch.
6. Install the transmission parking brake. Refer to Section 12-70, Parking Brake Cable Actuated, Transmission Mounted.
7. Connect the driveshaft. Refer to Section 15-62, Driveshaft, for procedure.
8. Install the upper shift lever to the lower shift lever.
9. Install the boot and bezel assembly to the transmission opening cover.
10. Install the upper shift lever to the lower shift lever and tighten the two retaining screws to 12-18 N·m (16-24 ft-lb).
11. Install the shift ball on the upper shift lever.

Crossmember**Removal**

1. Raise vehicle on a hoist.
2. Remove two nuts connecting upper gusset to frame on both sides of frame.
3. Remove nut and bolt assembly connecting gusset to crossmember. Remove gusset on left side.
4. Remove bolts holding transmission to transmission support plate on crossmember.
5. Raise transmission with a transmission jack.
6. Remove the nut and bolt assemblies connecting the support plate to the crossmember. Remove support plate. Remove right gusset.
7. Remove nut and bolt assemblies connecting crossmember to frame. Remove crossmember.

Installation

1. Install crossmember and transmission support plate, and position right and left gussets on bolts on frame. Install nuts on upper gusset to frame bolts and tighten to specification.
2. Install crossmember to frame nut and bolt assembly and tighten to specification.
3. Install nut and bolt assembly connecting gusset to crossmember and tighten to specification.
4. Install nut and bolt assemblies connecting transmission support plate to crossmember and tighten to specification.
5. Lower the transmission.
6. Install bolts connecting transmission support plate to transmission and tighten to specification.

SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	Quantity	Thread Description	Torque	
			N-m	Ft.-Lbs.
Drain Plug	1	M24x1.5	60	44
Oil Filler Plug	1	M24x1.5	60	44
Extension Adapter to Main Case	17	M8	22	16
End Yoke to Mainshaft	1	M24x1.25	250	184
Shift Tower Cover to Main Case	8	M8	22	16
P.T.O. Cover Plate			38	28
Idler Shaft Retention	2	M8	22	16
Shift Rail Plate	3	M6	10	7
Shift Cover to Tower Cover	3	M6	10	7
Reverse Switch	1	9/16-18NF	20	15

CC8828-2A

ZF M50D-HD LUBRICANT CAPACITY

Approximate Refill Capacity	
U.S. Pints	Liters
6.8	3.2

Fill to bottom of filler hole with ESP-M2C166-H (Motorcraft Mercon)

CC9049-1A

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Ford Motor Company

SECTION 22-08 7.3L V8 Diesel Engine

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	22-08-1	REMOVAL AND INSTALLATION (Cont'd.)	
REMOVAL AND INSTALLATION		Engine Rear Insulator	22-08-4
Engine Assembly	22-08-2	SPECIFICATIONS	22-08-5
Engine Front Insulators	22-08-3		

DESCRIPTION

For engine service procedures on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 22-08, 7.3L Diesel Engine in the 1988 Light Truck Engine Manual (Volume B):

ADJUSTMENTS 22-08-22

CLEANING AND INSPECTION

Camshaft	22-08-70
Connecting Rods	22-08-71
Crankcase Depression Regulator (CDR)	22-08-67
Crankshaft	22-08-70
Crankshaft Vibration Damper	22-08-70
Cylinder Block	22-08-72
Cylinder Heads	22-08-67
Drive Gears	22-08-70
Exhaust Manifolds	22-08-69
Flywheel	22-08-70
Automatic Transmission	22-08-70
Manual-Shift Transmission	22-08-71
Hydraulic Valve Tappets	22-08-69
Intake Manifold	22-08-69
Main and Connecting Rod Bearing	22-08-71
Oil Cooler	22-08-73
Thermostat	22-08-73
Oil Pan	22-08-73
Oil Pump	22-08-73
Pistons, Pins and Rings	22-08-72
Push Rods	22-08-67
Valve Rocker Arm Assembly	22-08-67

DESCRIPTION AND OPERATION

Coolant Flow	22-08-2
Dual Mass Flywheel (Manual Transmission Only)	22-08-6
Engine Components	22-08-3
Engine Description	22-08-2
Fuel Flow	22-08-3
Glow Plug Fast Start System	22-08-6
Injection Nozzle Assemblies	22-08-5
Injection Pump	22-08-4
Lubrication System	22-08-3
Vehicle and Engine Identification	22-08-8

DIAGNOSIS AND TESTING

Diagnostic Procedures — Engine	
Components	22-08-8
Camshaft End Play	22-08-21
Camshaft Lobe Lift	22-08-20
Compression Test	22-08-18

MAINTENANCE

Accelerator Linkage	22-08-74
Engine Fuel Filter	22-08-73
Engine Idle Speed	22-08-74
Engine Oil Level	22-08-73
Fuel Filter/Fuel Heater/Water Separator	22-08-74

REMOVAL AND INSTALLATION

Camshaft	22-08-58
Installation	22-08-58
Removal	22-08-58
Camshaft Bearings	22-08-59
Camshaft Drive Gear, Fuel Pump Cam, Spacer and Thrust Plate	22-08-37
Core Plugs	22-08-60
Crankcase Depression Regulator (CDR)	22-08-38
Crankshaft	22-08-57
Installation	22-08-58
Removal	22-08-57
Crankshaft Drive Gear	22-08-34
Crankshaft Vibration Damper	22-08-29
Cylinder Block	22-08-65
Cylinder Head	22-08-60
Cylinder Heads	22-08-50
Engine Assembly	22-08-22
Engine Front Cover and Crankshaft Oil Seal	22-08-31
Engine Oil Cooler	22-08-52
Engine Oil Filter	22-08-52
Engine Rear Insulator	22-08-28
Exhaust Manifolds	22-08-48
F-250-F-350	22-08-22
Fitting Main or Connecting Rod Bearings	22-08-63

DESCRIPTION (Continued)**REMOVAL AND INSTALLATION (Cont'd)**

Flywheel, Engine Rear Cover and Oil Seal	22-08-33
Flywheel Ring Gear	22-08-34
Front Crankshaft Oil Seal	22-08-30
In-Vehicle Replacement	22-08-30
Fuel Supply Pump	22-08-41
Injection Nozzle Fuel Lines	22-08-44
Injection Nozzles	22-08-45
Injection Pump	22-08-41
Injection Pump Drive Gear and Gear Cover	22-08-36
Intake Manifold, Valley Pan and Tappets	22-08-47
Oil Pan, Oil Pump and Oil Pick-Up Tube	22-08-53
Overhaul	22-08-55
Assembly	22-08-56
Cylinder Assembly—6009	22-08-55
Cylinder Block—6010	22-08-56
Disassembly	22-08-56

REMOVAL AND INSTALLATION (Cont'd)

Piston and Connection Rod Assembly	22-08-64
Pistons and Connecting Rods	22-08-56
Installation	22-08-56
Removal	22-08-56
Pistons, Pins and Rings	22-08-64
Repairing Engine Casting Holes and Porosities	22-08-66
Secondary Flywheel	22-08-34
Thermostat	22-08-49
Valve Cover, Rocker Arm, and Push Rod	22-08-38
Valve Spring, Retainer and Stem Seal	22-08-40
Valves	22-08-62
Camshaft Repair	22-08-62
Water Pump	22-08-28
SPECIFICATIONS	22-08-75
VEHICLE APPLICATION	22-08-2

REMOVAL AND INSTALLATION**Engine Assembly**

Refer to the body manufacturer's manual for engine removal, installation and access procedures.

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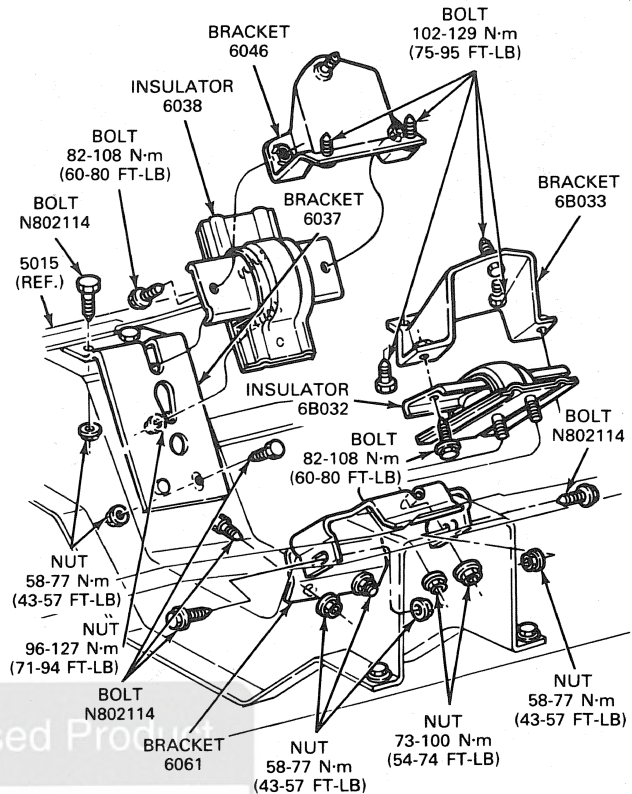
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REMOVAL AND INSTALLATION (Continued)

Engine Front Insulators

Removal

1. Disconnect ground cables from both batteries.
2. Remove fan shroud. Refer to Section 27-04, Radiators.
3. Raise vehicle.
4. Remove nuts attaching insulators to engine mounting bracket.
5. Disconnect muffler inlet pipes at exhaust manifolds.
6. Lower vehicle.
7. Install Rotunda Universal Load Positioning Sling 014-00036 or equivalent, to lifting eyes on engine and raise engine high enough for insulators to clear No. 2 crossmembers.
8. Remove bolts attaching insulators to engine block.
9. Remove insulator.
10. Remove nuts attaching engine mount brackets to No. 2 crossmember and remove brackets.



Installation

1. Install engine mount brackets if previously removed, and tighten to specifications.
2. Install insulator onto engine block and tighten to specifications.
3. Lower engine onto engine mount brackets.
4. Remove lifting sling.
5. Raise vehicle.
6. Install insulator-to-engine mount bracket attaching nuts and tighten to specifications.
7. Lower vehicle.
8. Install radiator fan shroud. Refer to Section 27-04, Radiators.
9. Connect ground cables to both batteries.

INSTALLATION - ENGINE MOUNTS FRONT

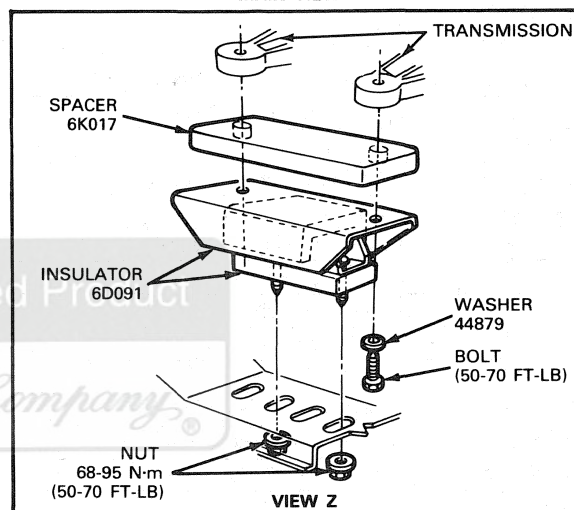
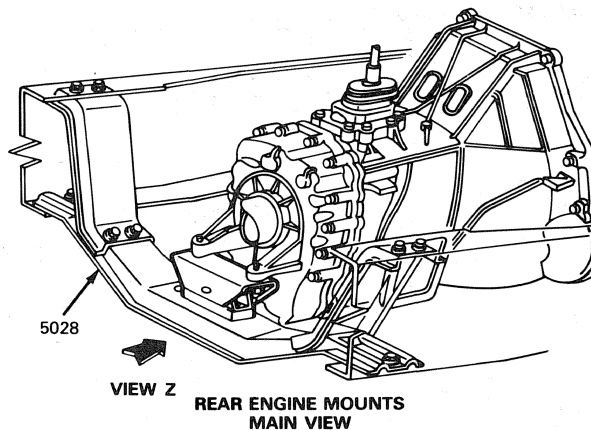
A11949-1A

REMOVAL AND INSTALLATION (Continued)**Engine Rear Insulator****Removal**

1. Remove the insulator-to-support assembly bolt and locknut.
2. Remove the insulator-to-transmission housing bolts and lockwashers.
3. Raise the transmission with a floor jack and remove the insulator and retainer.

Installation

1. Position the insulator and retainer to the transmission housing and install the attaching bolts and lockwashers, using the holes noted on removal. Tighten to specifications.
2. Lower the transmission and remove the jack.
3. Install the insulator-to-support assembly bolt and locknut. Tighten to specification.
4. Lower the vehicle.



A11950-1A

SPECIFICATIONS

SPECIAL SERVICE TOOLS

Tool Number	Description	Tool Number	Description
T50T-100-A	Impact Slide Hammer	D83T-6084-A	Exhaust Valve Seat Remover/Replacer
T59L-100-B	Impact Slide Hammer	D83T-6134-B	Cooling Jet Tube Target
D82L-800-B	Hammer	D83T-6136-A	Connecting Rod Installation Guides
T80T-4000-W	Driver Handle	D83T-6250-A	Cam Remover/Replacer Adapter
D78P-4201-F	Dial Indicator Bracketry	T83T-6316-A	Crank/Cam Gear and Damper Remover
D78P-4201-G	Dial Indicator — 1 Inch Travel	T83T-6316-B	Crank/Cam Gear and Damper Replacer
D81L-4201-A	Feeler Gauge	T74P-6375-A	Flywheel Holding Tool
Tool-4201-C	Dial Indicator w/Bracketry	T83T-6500-A	Tappet Bleed-Down Wrench
T77F-4220-B1	Gear Puller	Tool-6500-E	Hydraulic Tappet Leakdown Tester
T83T-6000-D6.9	6.9L Essential Service Tool Kit	Tool-6505-F	Valve Stem Clearance Tool
T70P-6000-	Engine Lifting Brackets	T83T-6513-A	Valve Spring Compressor
D81L-6002-B	Plastigage	Tool-6513-DD	Valve/Clutch Spring Tester
D81L-6002-C	Piston Ring Compressor	Tool-6565-AB	Cup Shaped Adapter
D81L-6002-D	Piston Ring Groove Cleaner	T83T-6571-A	Valve Stem Seal Replacer
D81P-6002-E	Valve Seat Runout Gauge	T83T-6700-A	Front Crank Seal Replacer
D83T-6002-A	Glow Plug Socket	T83T-6701-A	Rear Crankshaft Seal Replacer
D83T-6250-A	Camshaft Installation Adapter	T83T-6701-B	Rear Crankshaft Seal Pilot
T65L-6250-A	Camshaft Bearing Set	T86T-9000-C	Fuel Transfer Pump Pressure Adapter
T68P-6135-A	Piston Pin Remover/Replacer	T83T-9000-B	Injection Pump Mounting Wrench
T70P-6011-A	Expansion Plug Installer	T83T-9000-C	Injection Pump Rotating Tool
T83T-6312-A	Fan Clutch Pulley Holder	T83T-9395-A	Fuel System Protection Cap Set
T83T-6312-B	Fan Clutch Nut Wrench	T83T-9396-A	Fuel Line Nut Wrench
D83T-9000-E	Throttle Control	T83T-9424-A	Intake Manifold Cover
D83T-6015-A	Expansion Plug Replacer	T83T-9527-A	Nozzle Seat Cleaner
D83T-6134-A	Piston Cooling Jet Installer	T71P-19703-C	O-Ring Tool
D83T-6085-A	Valve Guide Tools		

CA7423-2E

ROTUNDA EQUIPMENT

Model Number	Description
014-00036	Universal Load Positioning Sling
014-00300	Injection Nozzle Tester
014-00301	Injection Nozzle Cleaning Kit
014-00306	Engine Stand Mounting Adapter
014-00312	Engine Lifting Bracket
014-00701	Compression Tester
014-00702	Pressure Test Kit
014-00726	Oil Cooler Internal Leakage Tester
112-00001	Oil Leak Detector

CA7424-1F

SECTION 25-02 Fuel Supply Pump — Diesel Engine

SUBJECT
DESCRIPTION **PAGE**
25-02-1

SUBJECT
SPECIFICATIONS **PAGE**
25-02-1

DESCRIPTION

For fuel pump service information on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 25-02, Fuel Supply Pump — Diesel Engine in the 1988 Light Truck Engine Manual (Volume B):

DIAGNOSIS 25-02-2
REMOVAL AND INSTALLATION 25-02-5
TESTING
Capacity (Volume) Test 25-02-4
Pressure Tests 25-02-4

SPECIFICATIONS

Engine Liter (CID)	Static Pressure kPa (PSI)①	Mounting Bolts N·m (Ft·Lb)	Fuel Lines to Pump N·m (Ft·Lb)
7.3L (445)	41-55 (6-8)	26-37 (19-27)	20-24 (15-18)

① On engine with temperatures normalized and at normal curb idle speed, transmission neutral.

CV5514-2B

ROTUNDA EQUIPMENT

Model	Description
059-00008	Vacuum and Pressure Tester
018-00003	Safety Can

CV2454-1E

SECTION 25-40 Air Cleaner — Diesel

SUBJECT	PAGE
DESCRIPTION	25-40-1

SUBJECT	PAGE
REMOVAL AND INSTALLATION	
Filter Element	25-40-2

DESCRIPTION

A dry-type air cleaner is standard equipment on F-Super Duty Commercial Stripped Chassis vehicles. Air is filtered through a pleated, chem-

ically treated paper element to remove contaminants before entering the engine induction system.

Official Licensed Product

Ford Motor Company®

REMOVAL AND INSTALLATION

Filter Element

Removal

1. Loosen wing bolt. Then, remove air cleaner assembly as a unit before disassembly.

Before installing a new element in the air cleaner, check the following items:

- a. Gasket surfaces should be clean and undamaged.
- b. Inlet tube should be clean and undamaged.
- c. Element should be dry and free of holes, ruptures, damaged gaskets or dents in end covers and liners.
- d. Element retaining nut or bolt should have the gasket washer attached and it should be in good condition.
- e. Inspect water drain hose for possible restrictions caused by contaminants. Replace hose (9F765) if cracked or damaged.

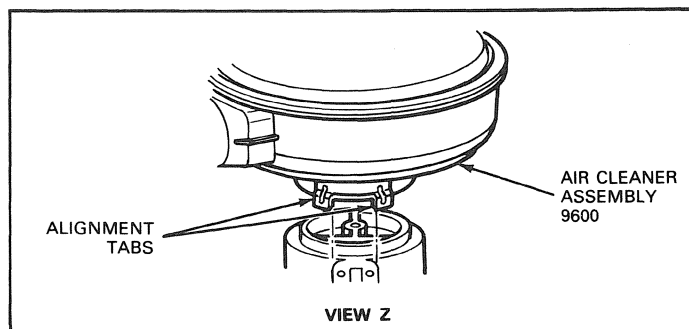
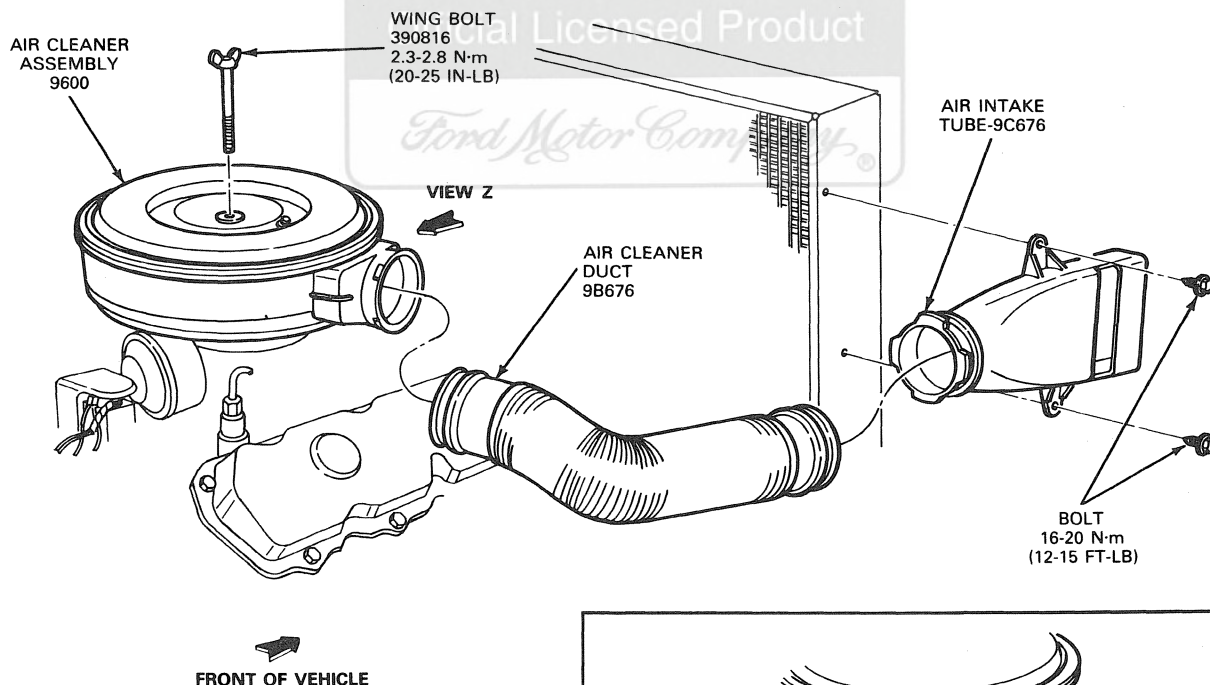
Installation

After the air cleaner, element, dust cup and other parts are found to be in good condition, reassemble the parts.

1. Install the element. Ensure the rubber face of the washer seals against the element.

CAUTION: A special water resistant element is required. Ensure to use only a specific Ford replacement. Use of other elements could result in serious engine damage.

2. Install the cover. Ensure gasket, if supplied, is in place. Replace a worn or damaged gasket.
3. Install air cleaner assembly and tighten wing bolt securely.
4. Ensure that the rubber water drain hose is not doubled under, kinked or bent and is positioned freely.



SECTION 25-50 Fuel Tanks and Lines — Diesel Engines

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	25-50-1	SPECIFICATIONS	25-50-5
REMOVAL AND INSTALLATION			
Aft Axle Frame-Mounted Tank	25-50-2		
Fuel Lines	25-50-5		

DESCRIPTION

F-Super Duty Commercial Stripped Chassis vehicles are equipped with a 40 gallon, rear mounted fuel tank. For fuel tank and line service, refer to the following pages in Section 25-50, Fuel Tanks and Lines — Diesel Engines in the 1988 Light Truck Engine Manual (Volume B):

DESCRIPTION

Fuel Tank Draining 25-50-1

Fuel Tank Filling 25-50-1
Fuel/Water Separator 25-50-2
 Drain Procedure 25-50-2
Push Connect Fittings 25-50-1

DIAGNOSIS 25-50-2

REMOVAL AND INSTALLATION

Major Service Operations 25-50-20

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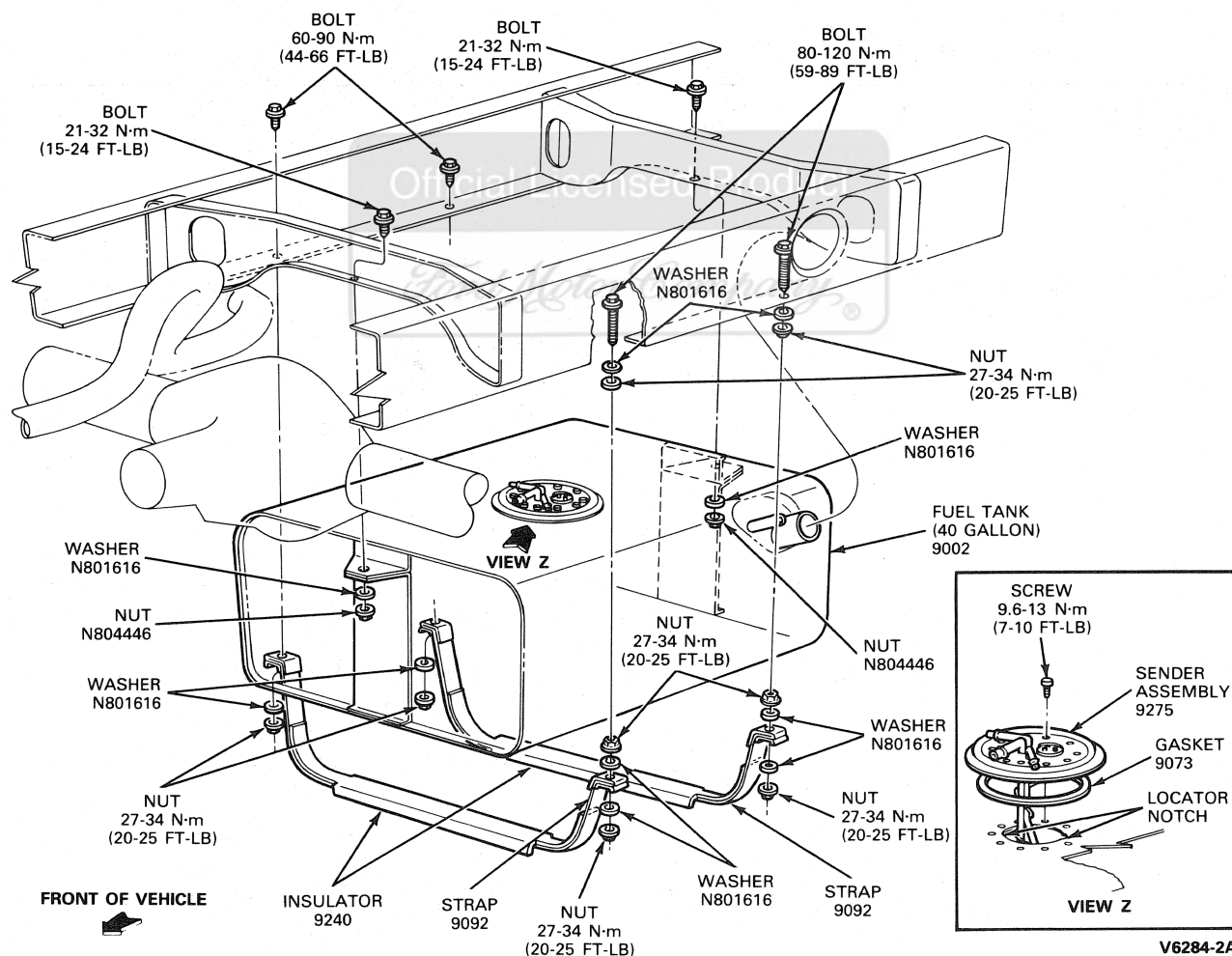
Ford Motor Company

REMOVAL AND INSTALLATION

Aft Axle Frame-Mounted Tank

Removal

- ## Aft Axle Frame-Mounted Tank
- ### Removal
1. Insert a siphon through the fuel filler pipe assembly and drain the fuel into a suitable container.
 2. To avoid electrical sparking at the tank, disconnect both battery ground cables.
 3. Raise the vehicle.
 4. Loosen the clamps on the fuel filler hose and vent hose at the tank neck. Disconnect the hoses from the tank.
 5. Disconnect the fuel line push connect fittings as outlined.
 6. Support the tank in position. Remove the nuts and bolts that attach the tank supports to the frame. Disengage the straps from the front tank support and the rear crossmember. Lower the tank and remove it from underneath the vehicle.
 7. If the fuel gauge sending unit is to be removed from the unit, remove the retaining bolts. Remove the sending unit and gasket.
 8. If the vapor control valve is to be removed, pull it out of the grommet located in the top of the tank, and remove the grommet.



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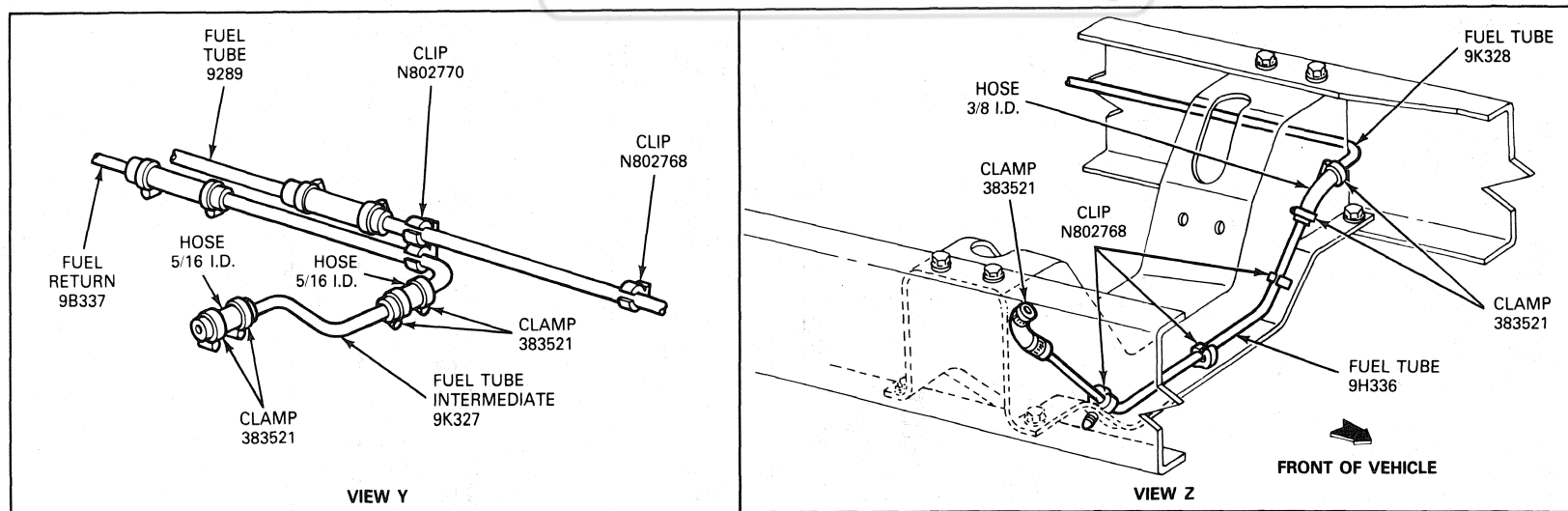
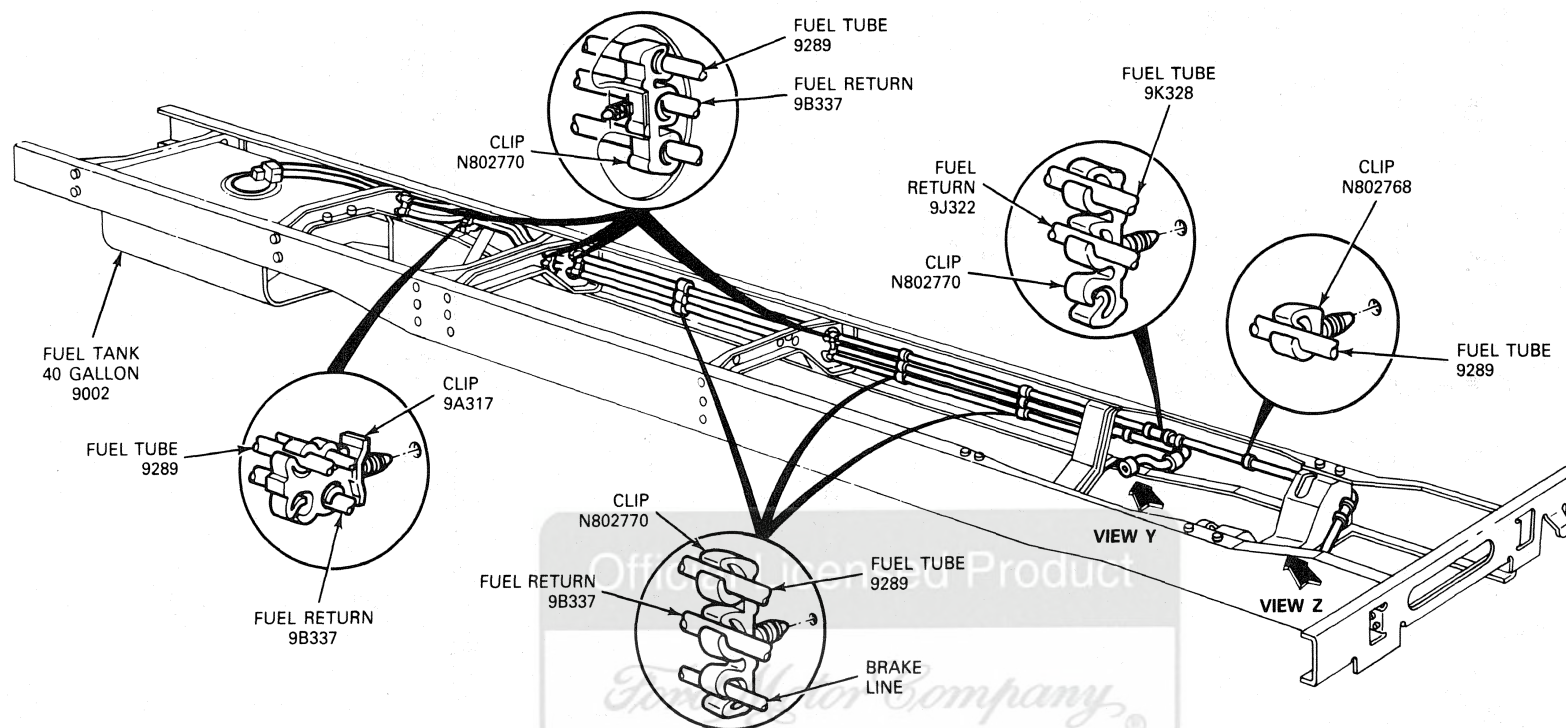
REMOVAL AND INSTALLATION (Continued)**Installation**

1. If the fuel gauge sending unit was removed, scrape away all the old gasket material from the unit mounting surfaces on the fuel tank. Using a new gasket, position the fuel gauge sending unit to the fuel tank and secure with the retaining bolts.
2. If the vapor valve was removed, install the grommet in the tank opening and press-fit the valve into place.
3. If the insulation pads were worn or damaged, remove the material and install new pads.
4. Raise the tank and attach the fuel sender electrical connector. Connect the fuel sender to the plastic fuel lines.
5. Attach the mounting straps to the crossmember in front of the tank with mounting bolts installed finger-tight.
6. Position the tank assembly against the top straps and insert the T-bolts into the rear crossmember. Tighten the T-bolt nuts to 27-34 N•m (20-25 ft-lb). Tighten the front bolts to 102-142 N•m (75-105 ft-lb).
7. Connect the fuel lines to the fuel gauge sending unit extension lines.
8. Connect the fuel filler hose to the filler neck and vent neck at the tank. Tighten the hose clamps to 3-4 N•m (25-35 in-lb).
9. Lower the vehicle.
10. Connect the vehicle battery ground cable removed in Step 2 of the removal procedure.
11. Fill the tank and check all connections for leaks.

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REMOVAL AND INSTALLATION (Continued)



V6285-2A

REMOVAL AND INSTALLATION (Continued)

Fuel Lines

Vehicles equipped with nylon fuel tubes and push connect fittings have three types of service that can be performed to the fuel lines: replacing nylon tubing (splicing nylon to nylon), replacing push connector fittings, and replacing damaged push connect tube end.

Splicing Nylon to Nylon

1. Relieve fuel system pressure as outlined. Read cautionary note prior to relieving pressurized fuel system.
2. Cut out damaged section of tubing and retain as a guide.
3. Cut a section of service tubing (type 11 or 12 nylon available in 9.5mm (3/8 inch), 7.9mm (5/16 inch) sizes) to the same length as the damaged section of tubing.

4. Select the proper 9.5mm (3/8 inch), 7.9mm (5/16 inch), barbed connectors for completing the splice. Two connectors are required for each splice.

NOTE: The connectors may be easily inserted into the nylon lines using Plastic Fuel Line Connector Tool-134-00001.

5. Install the barbed connectors into each end of the replacement tubing using Tool-134-00001.
6. Install clips onto any tubes which might be difficult to access once the final splices are completed.
7. Complete the splice of the replacement nylon to the original nylon tubing at both ends.
8. Install any remaining clips which were removed for this service and check that the tubes are secure in the original clips.
9. Start engine and check for leaks.

SPECIFICATIONS

Official Licensed Product

SPECIAL SERVICE TOOLS

Tool	Description
T63P-9171-A	Keystone Clamp Pliers
T74P-9275-A	Fuel Tank Sender Wrench
D87L-9280-A	Spring-Lock Coupling Tool - 3/8 inch
D87L-9280-B	Spring-Lock Coupling Tool - 1/2 inch
T83P-19623-C	Spring Lock Coupling Tool - 5/8 in.

CV5936-1A

ROTUNDA EQUIPMENT

Tool	Description
014-00702	Vacuum/Pressure Tester
034-00002	Fuel Storage Tanker
034-00006	Suction Pump
134-00001	Plastic Fuel Line Connector Tool

CV5937-1A

F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS, FUEL TANK CAPACITY

Wheel Base		Body Style	Tank Location	Tank Capacity	
mm	(Inch)			Liters	(Gallons)
4013	(158)	Stripped Chassis	Aft of Axle	151	(40)

CV6286-2A

SECTION 25-51 Fuel Filters — Diesel Engines

SUBJECT	PAGE
DESCRIPTION	25-51-1

DESCRIPTION

For fuel filter service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 25-51, Fuel Filters — Diesel Engines in the 1988 Light Truck Engine Manual (Volume B):

REMOVAL AND INSTALLATION	
Fuel Filter	25-51-1

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SECTION 25-60 Throttle Linkage — Diesel

SUBJECT
ADJUSTMENTS PAGE 25-60-1

SUBJECT
REMOVAL AND INSTALLATION PAGE 25-60-1

ADJUSTMENTS

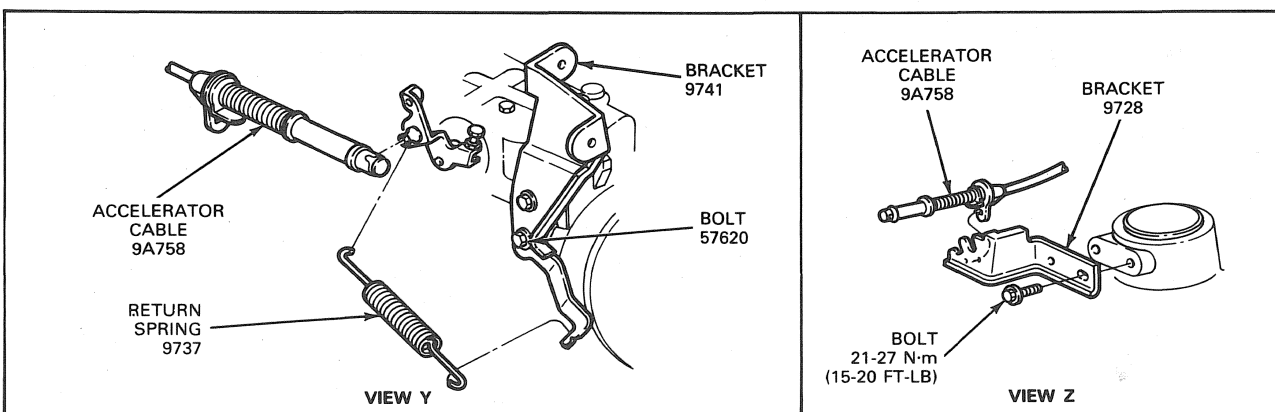
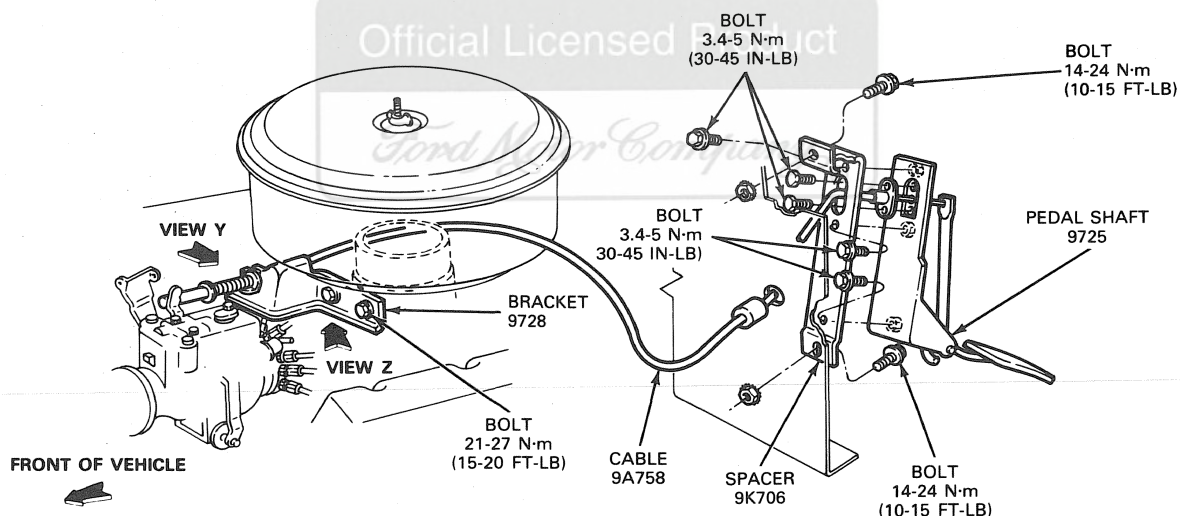
There are no adjustments required for the throttle linkage on F-Super Duty Commercial Stripped Chassis vehicles other than checking the linkage for freedom from binding, and checking for full throttle opening and free return.

CAUTION: Be sure to install throttle return springs in the manner shown in the illustration. After adjustment, the accelerator should return to idle on slow release of foot pressure, without binding or dragging.

REMOVAL AND INSTALLATION

Linkage disconnect points are shown in the following illustration.

NOTE: Refer to Adjustments for throttle return spring installation and accelerator operation.



SECTION 26-01 General Exhaust System Service

SUBJECT	PAGE
DESCRIPTION	26-01-1
DIAGNOSIS AND TESTING	
Restricted Exhaust System	
Test — Diesel Engines	26-01-1
REMOVAL AND INSTALLATION	
Muffler and Outlet Pipe	
Assembly	26-01-1

SUBJECT	PAGE
REMOVAL AND INSTALLATION (Cont'd.)	
Muffler Inlet Pipe Assembly	26-01-3
SPECIFICATIONS	26-01-3

DESCRIPTION

For exhaust system service information on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 26-01, General Exhaust System Service in the 1988 Light Truck Engine Manual (Volume B):

ADJUSTMENTS	
Exhaust System Alignment	26-01-2
Brush Shield Inspection	26-01-2
DESCRIPTION	26-01-1
DIAGNOSIS AND TESTING	
Diagnosis Guides	26-01-2

DIAGNOSIS AND TESTING

Restricted Exhaust System Test — Diesel Engines

Visually inspect the vehicle's exhaust system for dents or kinks which could cause restrictions.

REMOVAL AND INSTALLATION

Muffler and Outlet Pipe Assembly

Removal

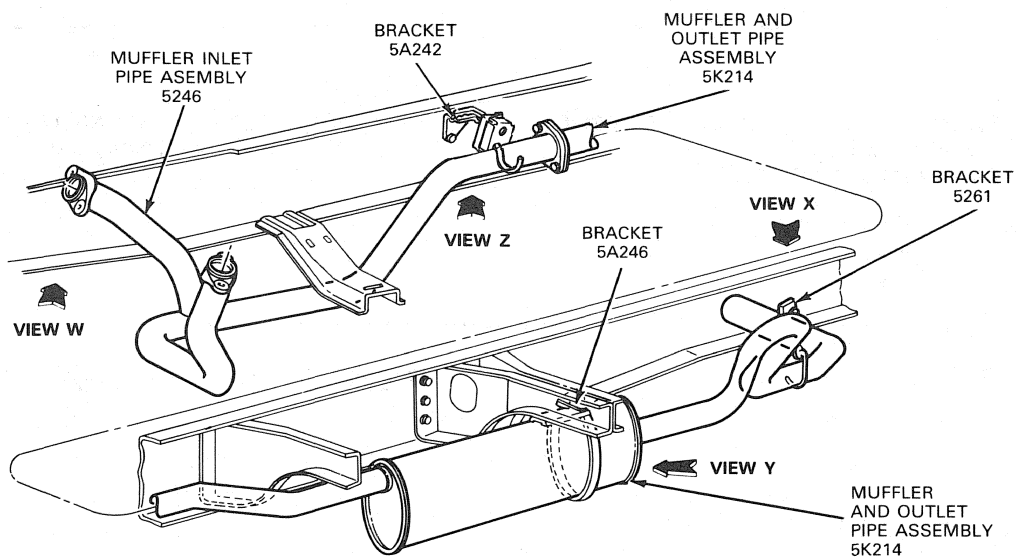
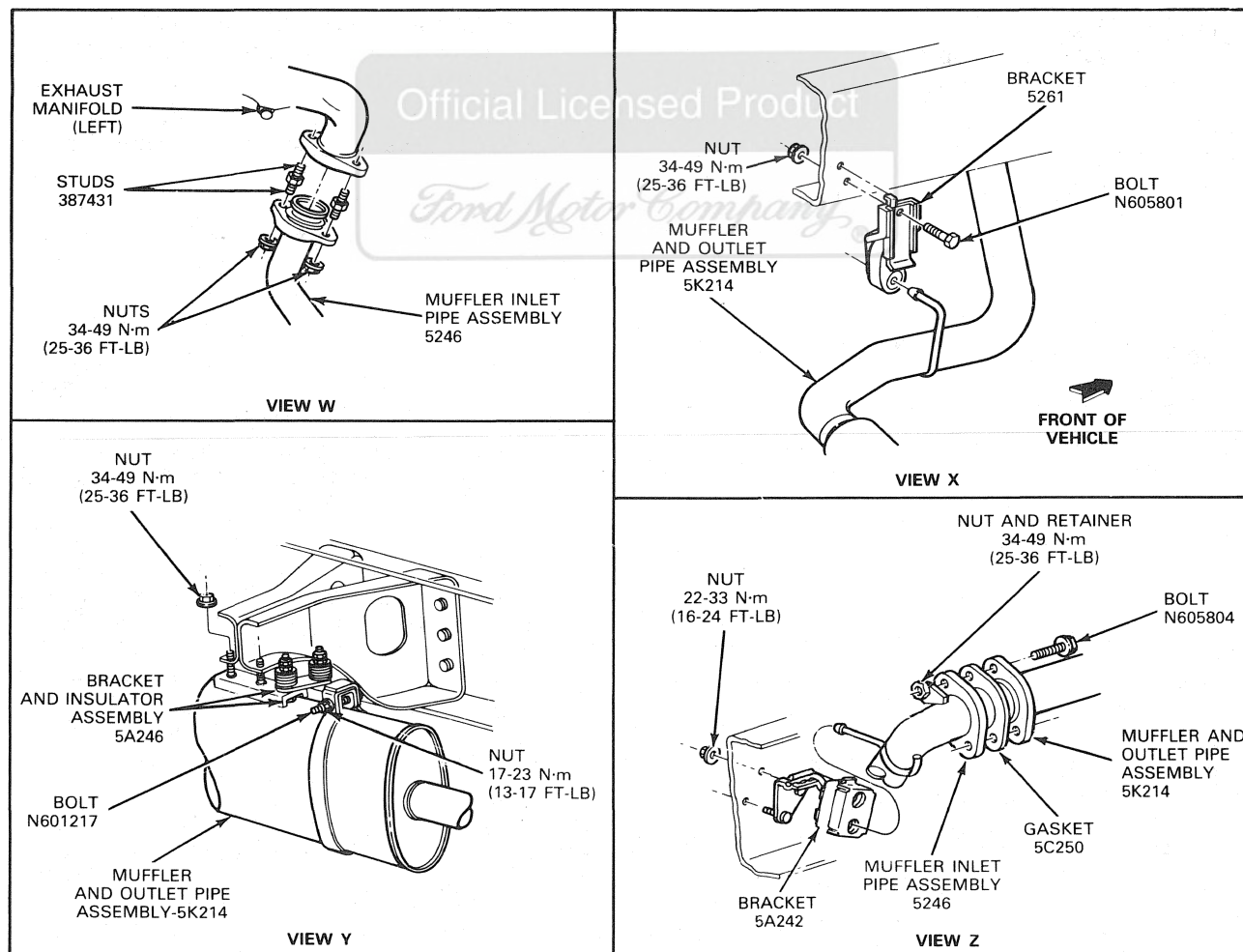
NOTE: The muffler and outlet pipe are serviced as an assembly.

1. Remove the two bolts securing the muffler assembly flange to the muffler inlet pipe flange.
2. Remove the nut and bolt from the outlet pipe hanger assembly, and remove the hanger from the outlet pipe.
3. Disconnect the muffler hanger, and remove the muffler and outlet pipe assembly from the vehicle.

Installation

1. Position the muffler and outlet pipe assembly and install the muffler hanger nuts. Tighten the nuts to 34-49 N•m (25-36 ft-lb).
2. Install the outlet pipe hanger and install the hanger bolt and nut. Tighten the nut to 34-49 N•m (25-36 ft-lb).
3. Install the nuts and bolts securing the muffler flange to the muffler inlet pipe. Check for exhaust system to driveline clearance. Tighten the nuts to 34-49 N•m (25-36 ft-lb).

REMOVAL AND INSTALLATION (Continued)

7.3L DIESEL WITH M50 D
MANUAL TRANSMISSION

REMOVAL AND INSTALLATION (Continued)

Muffler Inlet Pipe Assembly

Removal

1. Remove the nuts and bolts securing the muffler inlet pipe flange to the muffler assembly flange.
2. Remove the nut and bolt from the inlet pipe hanger assembly, and remove the hanger from the inlet pipe.
3. Remove the nuts securing the muffler inlet pipe to the exhaust manifolds, and remove the muffler inlet pipe from the vehicle.

Installation

1. Install the nuts securing the muffler inlet pipe to the exhaust manifolds.
2. Install the nuts and bolts securing the muffler inlet pipe to the muffler flange.
3. Check the exhaust system for clearance and tighten all nuts to 34-49 N•m (25-36 ft-lb).

SPECIFICATIONS

TORQUE SPECIFICATIONS

Item	Torque	
	N•m	(Ft-Lb)
Muffler Hanger Nuts	34-49	(25-36)
Outlet Pipe Hanger Nut	34-49	(25-36)
Muffler Flange to Muffler Inlet Pipe	34-49	(25-36)
Muffler Inlet Pipe to Exhaust Manifold Nuts	35-45	(25-36)
Muffler Inlet Pipe Hanger Bracket Nuts	17-23	(13-17)

CU1996-2A

TORQUE LIMITS — EXHAUST SYSTEM BOLTS AND NUTS —

UNLESS OTHERWISE SPECIFIED, THE FOLLOWING TORQUE RANGES ARE TO BE USED FOR FITTING OR FASTENER DIAMETERS AS INDICATED.

Bolt or Nut Diameter	Torque Range	
	Class 9.8 (Grade 5)	Class 10.9 (Grade 8)
8mm (5/16 inch)	20-27 N•m (14-19 ft-lb)	26-35 N•m (20-25 ft-lb)
10mm (3/8 inch)	37-50 N•m (28-36 ft-lb)	47-64 N•m (34-47 ft-lb)
12mm (7/16 inch)	65-90 N•m (48-66 ft-lb)	80-110 N•m (59-80 ft-lb)

CU1988-1B

SECTION 27-02 Cooling System Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	27-02-1	SPECIFICATIONS	27-02-1

DESCRIPTION

For cooling system service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 27-02, Cooling System Service in the 1988 Light Truck Engine Manual (Volume B):

CLEANING AND INSPECTION

Cleaning Cooling System	27-02-5
Heater Core Back-Flushing	27-02-5
Radiator Coolant Level Check	27-02-5
Radiator Pressure Cap	27-02-8

DESCRIPTION AND OPERATION

Coolant Recovery System	27-02-2
-------------------------------	---------

DIAGNOSIS AND TESTING

Visual Inspection	27-02-2
Cooling System Pressure Test	27-02-2
Diagnosis	27-02-4
Diagnosis Guides	27-02-4
Draining, Filling and Bleeding the Cooling System	27-02-4
Radiator Cap Pressure Test	27-02-3
Thermostat Test	27-02-3

REMOVAL AND INSTALLATION

Thermostat	27-02-8
Coolant Recovery Bottle	27-02-9

SPECIFICATIONS

ENGINE COOLING SYSTEM REFILL CAPACITIES

Engine	Model	Equipment	Approximate Capacity		
			U.S. Quarts	Imp. Quarts	Liters
7.3L Diesel	F-Super Duty Commercial Stripped Chassis	All Options	29*	23*	27*

*Includes 5 quarts (or equivalent liters or imperial quarts) in reservoir bottle.

CQ1771-2A

COOLING SYSTEM PRESSURES kPa (PSI)

Model	Operating Pressure	Minimum Test Pressure
F-Super Duty Commercial Stripped Chassis	90 (13)	70 (10)

CQ1772-1A

SECTION 27-04 Radiators

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	27-04-1	SPECIFICATIONS	27-04-5
REMOVAL AND INSTALLATION			
Radiator and Fan Shroud	27-04-1		

DESCRIPTION

For radiator service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 27-04, Radiators in the 1988 Light Truck Engine Manual (Volume B):

SERVICE PROCEDURES

Copper/Brass Radiators	27-04-12
Radiator Core Service	27-04-17

TESTING	27-04-4
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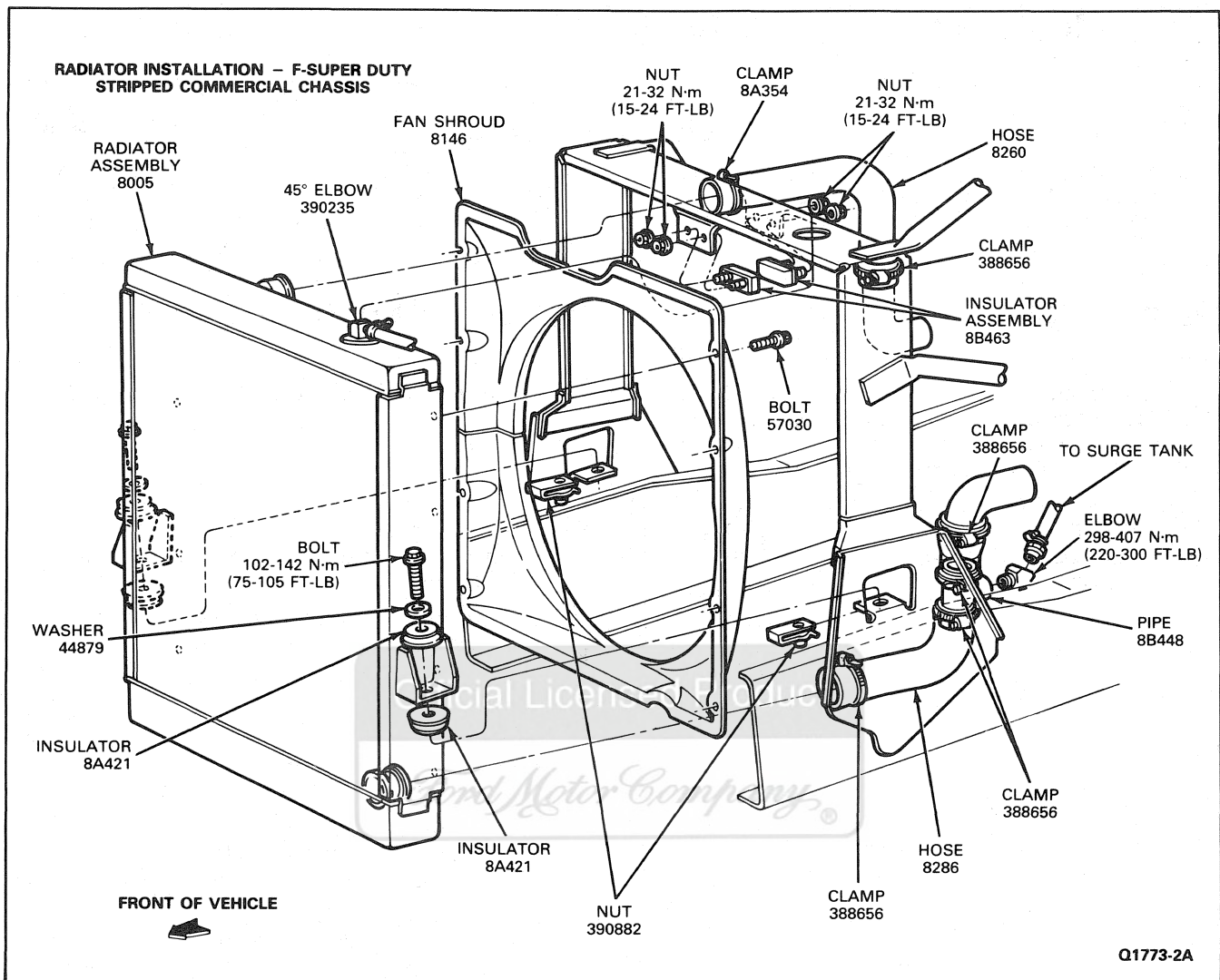
REMOVAL AND INSTALLATION

Radiator and Fan Shroud

Removal

1. Drain the radiator by removing the radiator cap and disconnecting the lower radiator hose. To prevent coolant loss when draining the radiator, drain the radiator into a clean container.
2. Remove the rubber overflow tube from the coolant recovery reservoir.
3. Remove the fan shrouds eight attaching bolts, lift the shroud back and drape it over the fan.
4. Loosen the upper radiator hose clamp, and remove the hose from the radiator.
5. Remove the two radiator attaching bolts from the side mounts, and remove the rubber insulators from the mounting pads.
6. Remove the radiator from the vehicle by pulling out slightly at the bottom to clear the side mounts, and then pull the radiator out through the bottom.
7. Lift the fan shroud off the fan and remove from the vehicle.

REMOVAL AND INSTALLATION (Continued)



REMOVAL AND INSTALLATION (Continued)**Installation**

1. Position the fan shroud on the fan.
2. Install the radiator from the bottom into the upper radiator insulators, then install the rubber insulators and the mounting bolts. Tighten the bolts to 102-142 N·m (75-105 ft-lb).
3. Install the upper and lower radiator hoses and tighten the hose clamps.
4. Install the fan shroud and tighten the eight shroud bolts.
5. Install the overflow hose to the coolant recovery bottle.

WARNING: DO NOT STAND IN LINE WITH OR NEAR THE RADIATOR FAN WHEN THE ENGINE IS RUNNING.

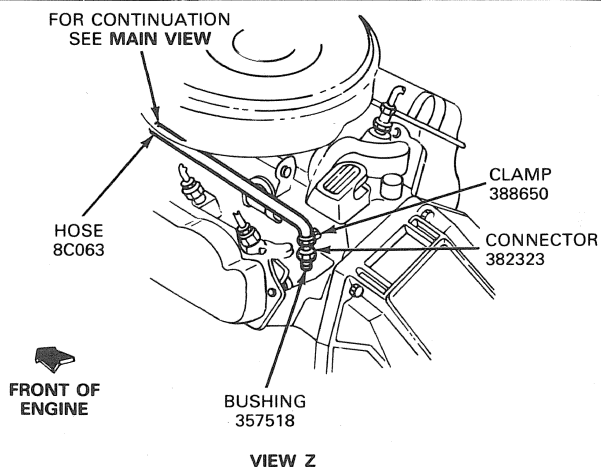
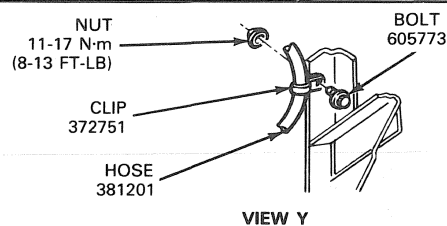
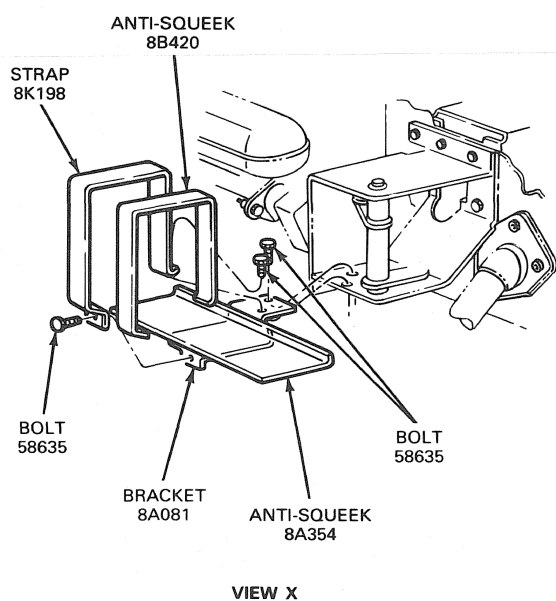
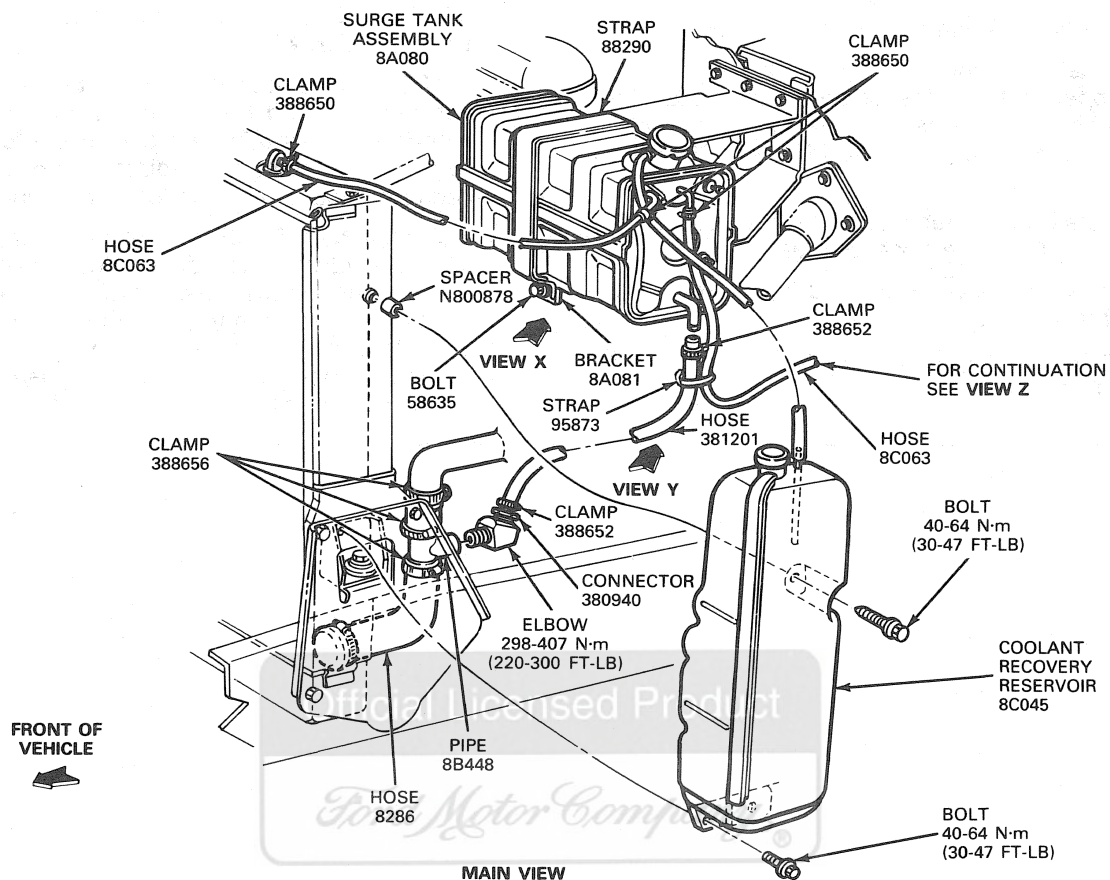
NOTE: A coolant mixture of 50 percent coolant concentrate and 50 percent water is recommended to maintain best overall performance. To avoid damaging the radiator the coolant concentrate should not exceed 60 percent.

6. Install new 50/50 mixture of water and ethylene glycol and operate the engine for 15 minutes. Check the coolant level and bring it up to within 38 mm (1-1/2 inches) of the radiator filler neck. Add two cooling system protection pellets. Part Number D9AZ-19558-A or equivalent.

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REMOVAL AND INSTALLATION (Continued)



SPECIFICATIONS**TORQUE SPECIFICATIONS**

Description	Torque	
	N-m	Ft-Lb
Radiator mounting bolts	102-142	75-105
Upper insulator pad nuts	21-32	15-24

CQ1775-1A

ROTUNDA EQUIPMENT

Model	Description
021-00012	Cooling System Pressurization Kit

CQ1776-1A

COOLING SYSTEM PRESSURES kPa (PSI)

Model	Operating Pressure	Minimum Test Pressure
F-Super Duty Commercial Stripped Chassis	90 (13)	70 (10)

CQ1772-1A

Official Licensed Product

Ford Motor Company

SECTION 28-02 Positive Engagement Starter

SUBJECT **PAGE**
DESCRIPTION 28-02-1

SUBJECT **PAGE**
SPECIFICATIONS 28-02-1

DESCRIPTION

For starter service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 28-02, Positive Engagement Starter in the 1988 Light Truck Engine Manual (Volume B):

DESCRIPTION AND OPERATION 28-02-1

DISASSEMBLY AND ASSEMBLY

Armature Replacement 28-02-5
 Brush Replacement 28-02-4
 Cleaning and Inspection 28-02-3
 Starter Drive Replacement 28-02-4

REMOVAL AND INSTALLATION 28-02-2

TESTING

Bench Tests 28-02-2

Armature and Field Grounded
 Circuit Test 28-02-2
 Armature Open Circuit Test 28-02-2
 Starter No Load Test 28-02-2
 On Vehicle Testing 28-02-1
 If Starter Cranks Slowly 28-02-1
 If Starter Does Not Crank
 and Relay Chatters Or Does
 Not Click 28-02-2
 If Starter Does Not Crank
 But Starter Relay Operates 28-02-1
 If Starter Spins (Humming
 Noise) But Does Not Crank
 Engine 28-02-2
 Starter Load Test 28-02-2
 Road Service 28-02-1

SPECIFICATIONS

POSITIVE ENGAGEMENT STARTER

Positive Engagement Starter Motor				Starter Brushes			Through Bolt Torque N-m (In-lbs)	Mounting Bolt Torque N-m (ft-lbs)
Dia. mm (Inches)	Current Draw Under Normal Load (Amps)	Normal Engine Cranking Speed (rpm)	Current Draw No. Load (Amps)	Mfg. Length mm (Inches)	Wear Limit mm (Inches)	Spring Tension kg (Ounces)		
101.60 (4)	150-200	180-250	60-85	12.2 (0.50)	6.35 (0.25)	1.134 (40)	6.21-8.47 (55-75)	21-27 (15-20)
114.30 (4.5)	150-180	150-290	70-85	12.2 (0.50)	6.35 (0.25)	1.134 (40)	6.21-8.47 (55-75)	21-27 (15-20)

Maximum Commutator runout is 0.1270mm (0.005 inch). Maximum starting circuit voltage drop (battery positive terminal to starter terminal) at normal engine temperature is 0.5 volt.

CJ2798-2A

SPECIAL SERVICE TOOLS

Tool No.	Description
TOOL-10044-A	Generator Pole Screw Wrench
TOOL-4201-C	Dial Indicator

CJ2799-1A

ROTUNDA EQUIPMENT

Number	Description
078-00005	Starting and Charging Tester

CJ3688-1A

SECTION 31-02 Batteries

SUBJECT	PAGE
DESCRIPTION	31-02-1

SUBJECT	PAGE
REMOVAL AND INSTALLATION	
Battery	31-02-1
SPECIFICATIONS	31-02-4

DESCRIPTION

For battery service on F-Super Duty Commercial Stripped Chassis vehicles, refer to the following pages in Section 31-02, Batteries in the 1988 Light Truck Body/Chassis/Electrical Manual (Volume A):

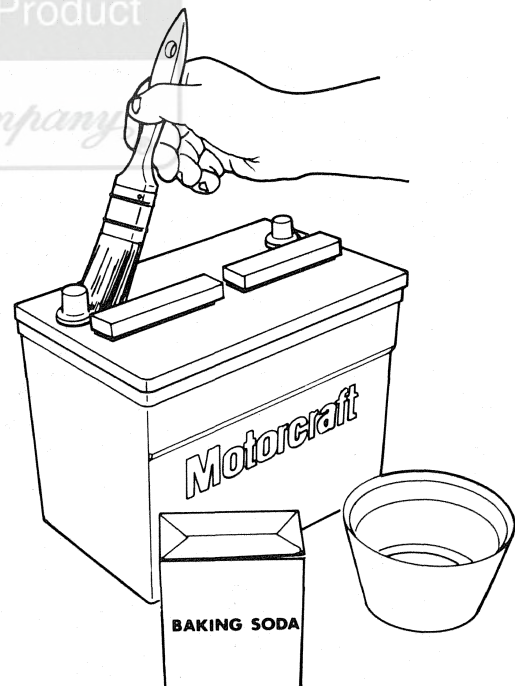
MAINTENANCE	
Battery Cleaning	31-02-4
Jump Starting	31-02-4
SERVICE	
Tools	31-02-7
TESTING	
Battery Charging	31-02-3
Battery State of Charge	31-02-1

REMOVAL AND INSTALLATION

Battery

Removal

1. Remove battery cables from battery terminals (negative first).
2. Clean cable terminals with an acid neutralizing solution and terminal cleaning brush.
3. Remove hold-down clamps.
4. Test battery and determine if it should be:
 - Returned to service.
 - Recharged before being returned to service.
 - Replaced with a Motorcraft or equivalent battery.

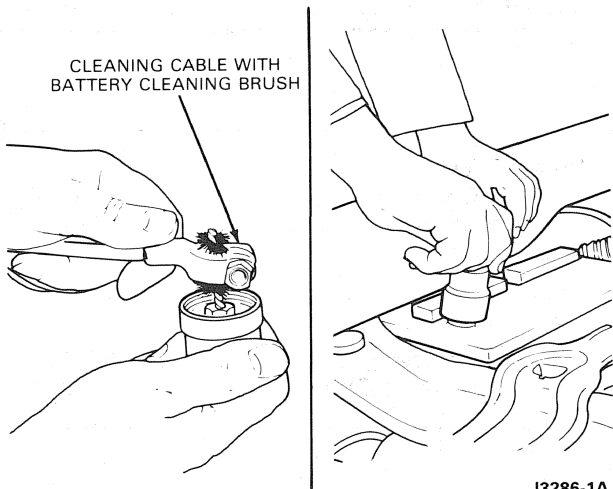


J3285-1A

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Clean cable terminals and hold-down with a wire brush. Replace all cables or parts that are worn or frayed.

CLEANING CABLE WITH
BATTERY CLEANING BRUSH



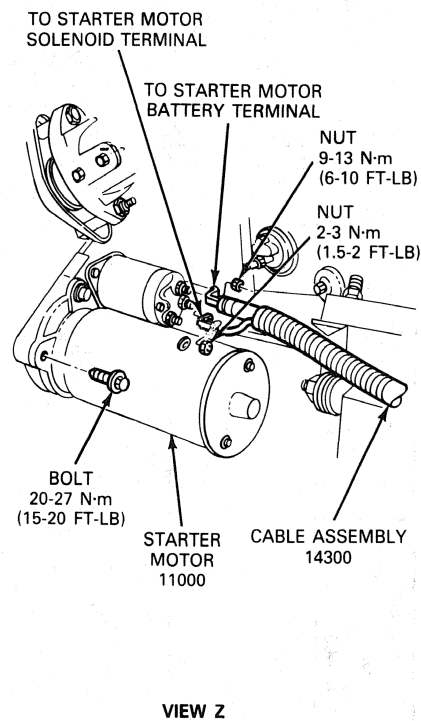
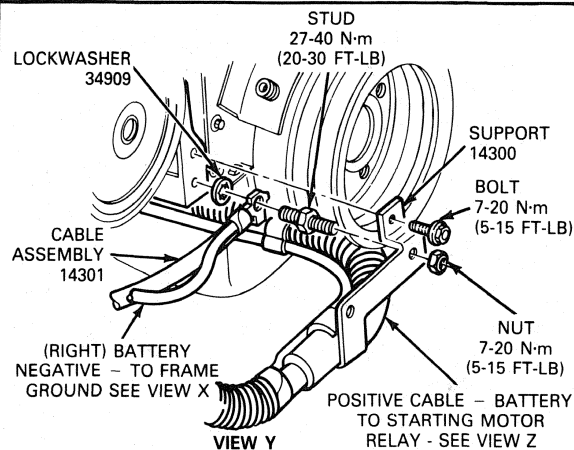
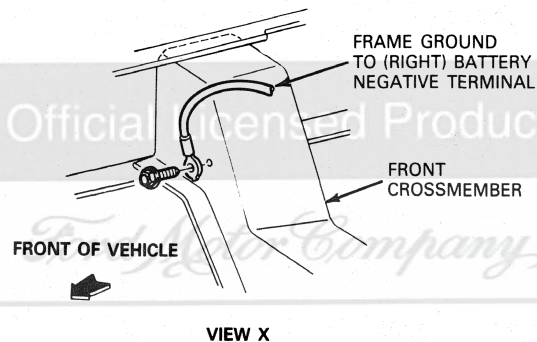
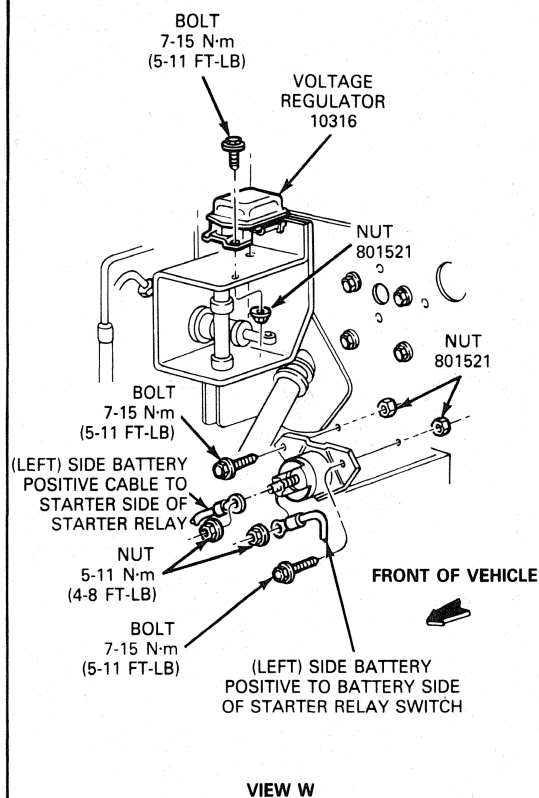
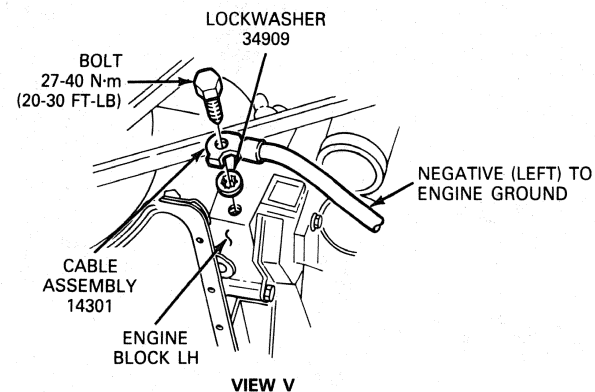
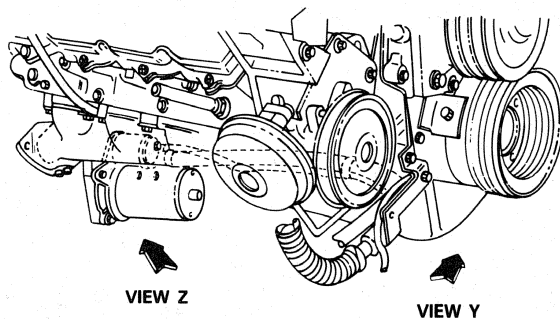
J3286-1A

2. Clean battery tray with a wire brush and scraper.
3. Place battery into tray with positive and negative terminals in same position as originally installed battery. Assemble and tighten hold-down hardware to ensure that battery is secure. Do not overtighten.
4. Secure cables (positive first) to proper terminals. **Do not overtighten.** Apply a small quantity of Long Life Lubricant C1AZ-19590-BA or equivalent to terminals.

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REMOVAL AND INSTALLATION (Continued)

BATTERY CABLE CONNECTIONS - F-SUPER DUTY
COMMERCIAL STRIPPED CHASSIS

J2796-2A

SPECIFICATIONS

ROTUNDA EQUIPMENT	
Tool Number	Description
078-00005	Starting and Charging Tester
021-00046	Battery and Anti-Freeze Tester
CJ3682-1A	

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SECTION 33-51 Instrument Cluster — Conventional

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION (Cont'd.)	
Four Gauge Cluster	33-51-2	Printed Circuit Cluster	33-51-4
REMOVAL AND INSTALLATION			
Cluster Assembly	33-51-2		

DESCRIPTION

The cluster warning lamps are located in two vertical columns, one on each side of the cluster. The LH and RH columns are as follows:

LH side, top-to-bottom

- Service engine soon
- Battery (ISO)
- Engine (ISO)
- Check oil
- Fuel Filter
- Washer fluid

RH side, top-to-bottom

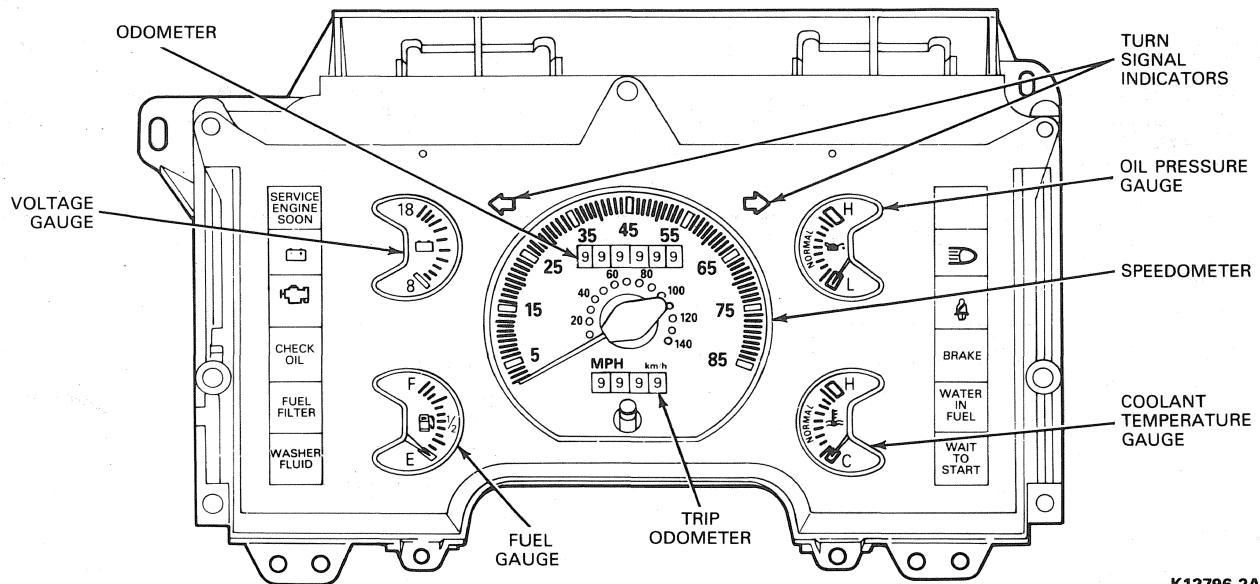
- Blank
- High beam (ISO)
- Fasten belts (ISO)
- Brake
- Water in fuel
- Wait to start

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DESCRIPTION (Continued)

Four Gauge Cluster



The voltage gauge is located to the upper left of the speedometer and the fuel gauge is located to the lower left of the speedometer.

The oil pressure gauge is located to the upper right of the speedometer and the temperature gauge is located to the lower right of the speedometer.

The turn signal indicator lamps are located above each side of the speedometer.

The speedometer has a circular shaped dial located above the steering column. It has a black background with white, orange and red graduations for mph and blue numerals for km/h.

The trip odometer is located on the lower part of the speedometer dial. The numerals are white on black, except the tenths which are black on white.

REMOVAL AND INSTALLATION

CAUTION: The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (dichlorobenzene, ethyl alcohol and/or cellosolve) has produced fogging, spotting, staining, or splotches of the lenses, either through overspray, or direct use on the lenses. Therefore, extreme caution should be taken during interior clean-up to prevent overspray of cleaning agents which contain the chemical

agents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ford Ultra-Clear Spray Glass Cleaner E4AZ-19C507-AA or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been especially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow directions shown on the container for best results.

REMOVAL AND INSTALLATION (Continued)**Cluster Assembly****Removal**

1. Disconnect the battery ground cable(s).
2. Remove five cluster bezel-to-panel retaining screws and remove the cluster.

3. Disconnect two wiring harness connectors from backplate.
4. Disengage speedometer cable from speedometer.

Installation

1. Apply approximately 4.80mm (3/16 inch) diameter ball of D7AZ-19A331-A Silicone Dielectric compound or equivalent in the drive hole of the speedometer head.
2. Position the cluster near its opening in the instrument panel.
3. Connect the speedometer cable (quick disconnect) to the speedometer head. Connect

the speedometer cable and housing assembly to the transmission (if removed).

4. Connect two wiring harness connectors to the backplate.
5. Position cluster to instrument panel and install the five cluster-to-panel retaining screws.
6. Connect the battery ground cable(s).
7. Check operation of all gauges and lamps.

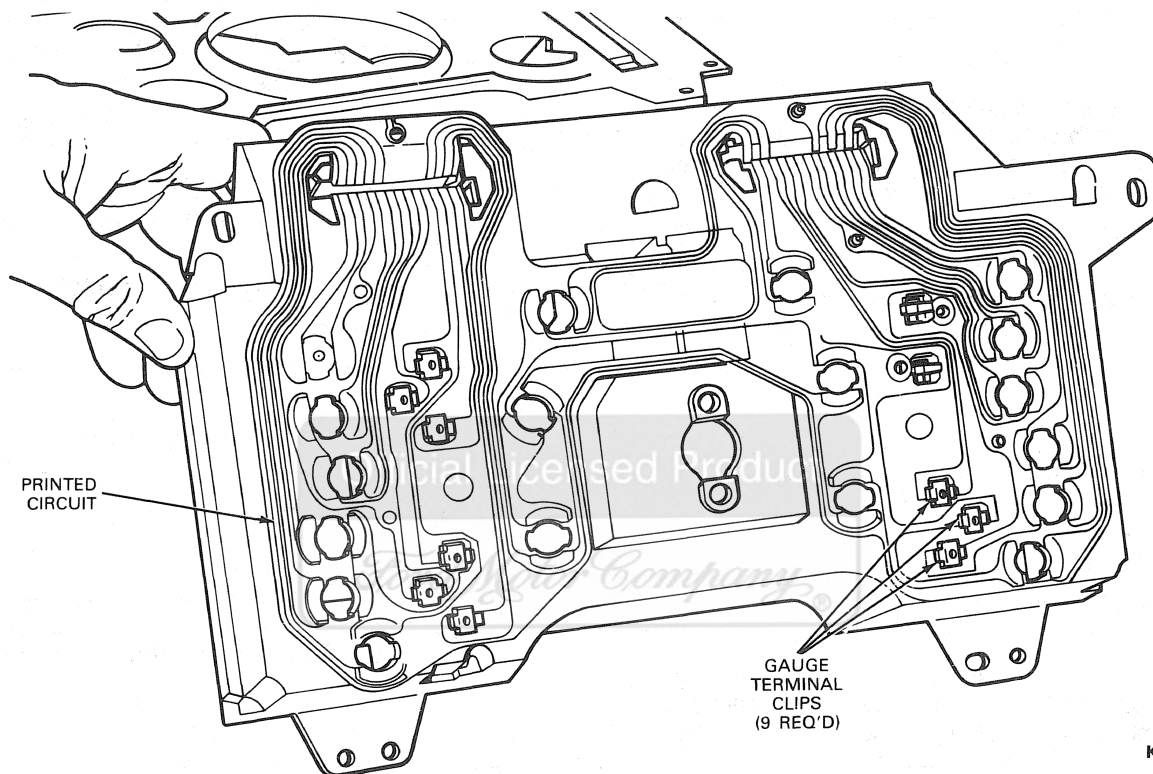
Printed Circuit Cluster**Removal**

1. Disconnect battery ground cable(s).
2. Remove the instrument cluster assembly from the instrument panel as outlined.
3. Remove the six screws that retain the bezel, mask and lens to the cluster backplate and remove the mask and lens.

4. Remove the six screws retaining the four gauges and remove gauges.
5. Using a pair of needle-nose pliers remove the nine gauge terminal clips by squeezing both ends of the gauge terminal clip and push through the clip opening in the backplate. Remove lamp bulbs and printed circuit.

REMOVAL AND INSTALLATION (Continued)**Installation**

1. Carefully position the printed circuit to the back of the cluster and engage it to the plastic location pins.
2. Install the gauge terminal clips and lamp bulbs.
3. Install cluster gauges and secure with screws.
4. Install the bezel, mask and lens to backplate and secure with screws.
5. Install instrument cluster assembly to instrument panel.
6. Connect the battery ground cable(s).
7. Check operation of all gauges and lamps.



K8832-2B

SECTION 34-02 Wiring Light Truck

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION	34-02-1		

REMOVAL AND INSTALLATION

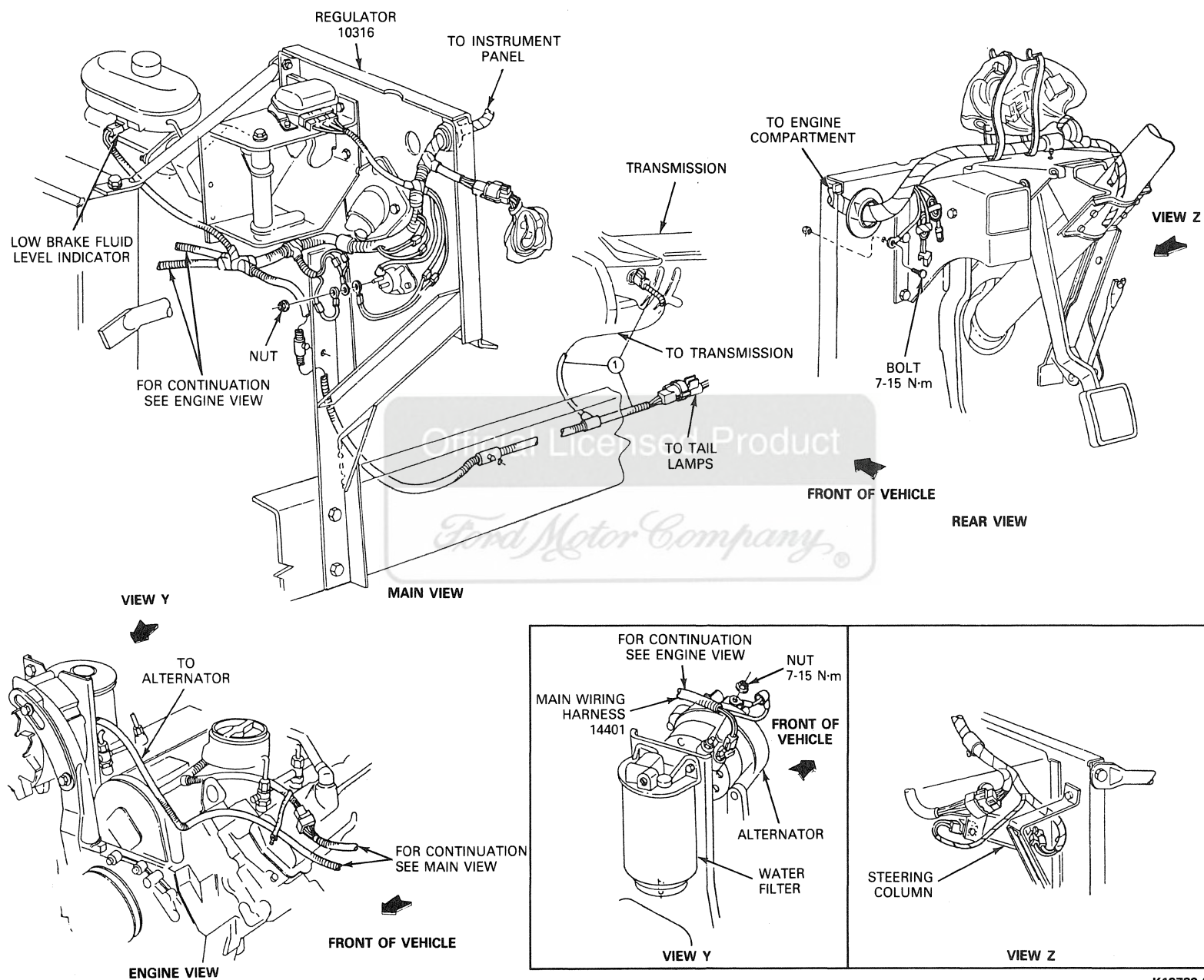
The illustrations in this Section show the complete wiring harness installation for F-Super Duty Commercial Stripped Chassis vehicles. Refer to the illustrations for the applicable harness while

performing Removal and Installation procedures. Refer also to the wiring schematic located in the back of this manual.

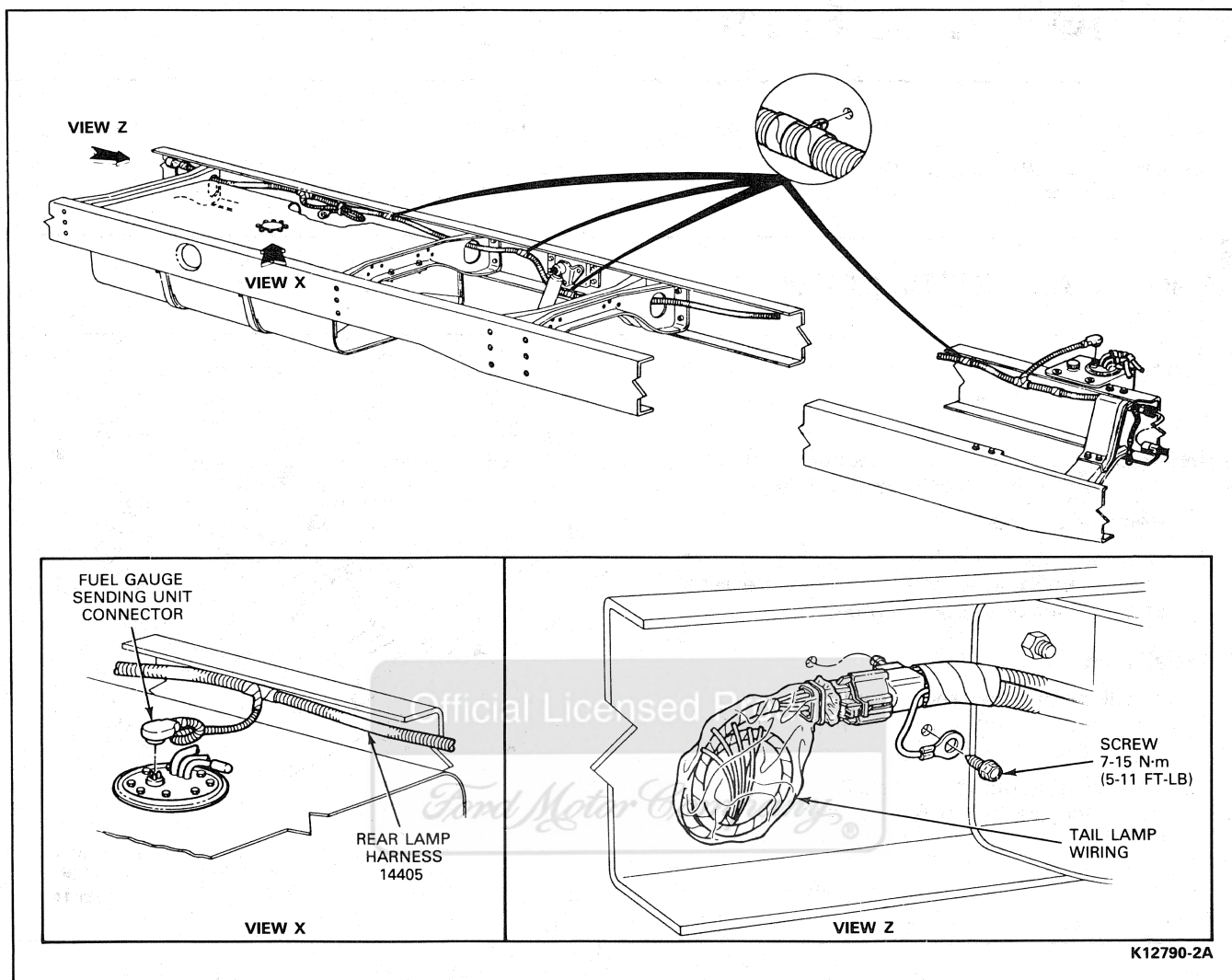
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REMOVAL AND INSTALLATION (Continued)



REMOVAL AND INSTALLATION (Continued)



SECTION 47-30 Frame

SUBJECT	PAGE
REMOVAL AND INSTALLATION	
Front Bumper	47-30-3

SUBJECT	PAGE
REMOVAL AND INSTALLATION (Cont'd.)	
Frame Crossmembers	47-30-4

REMOVAL AND INSTALLATION

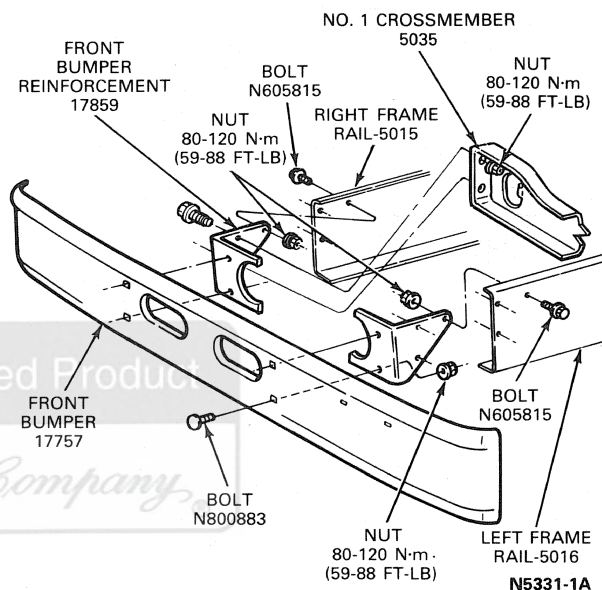
Front Bumper

Removal

1. Remove nuts and bolts retaining the front bumper to the reinforcement brackets.
2. Remove bumper.
3. Remove nuts and bolts retaining the bumper reinforcement brackets to the frame rails and number one crossmember.

Installation

1. Install the bumper reinforcement brackets if removed, tighten the retaining bolts to 80-120 N·m (59-88 ft-lb).
2. Position the bumper, install the nuts and bolts, and tighten to 80-120 N·m (59-88 ft-lb).

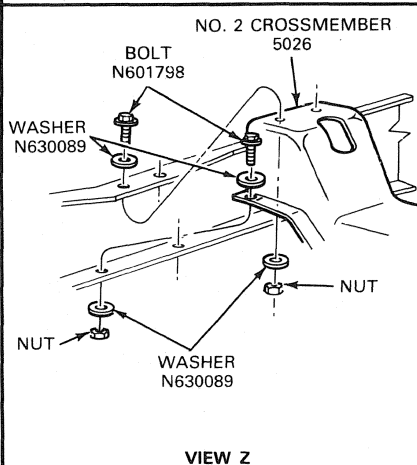
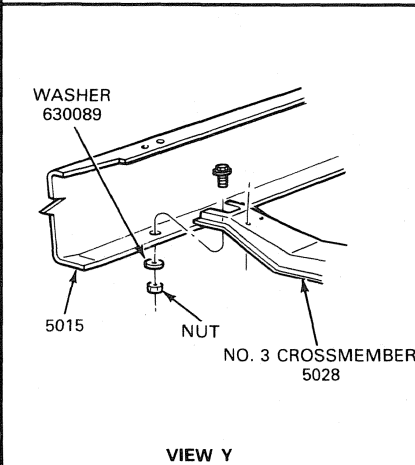
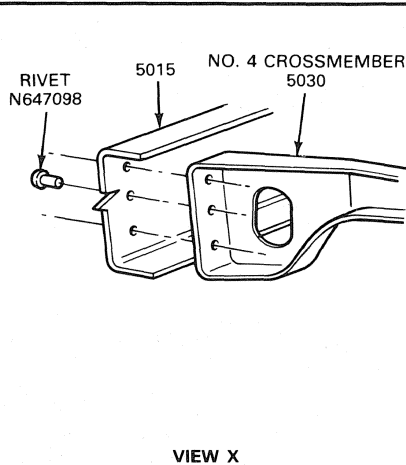
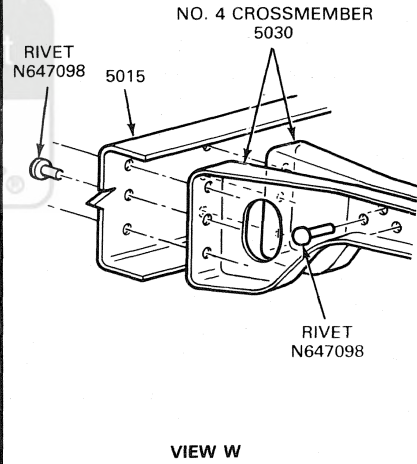
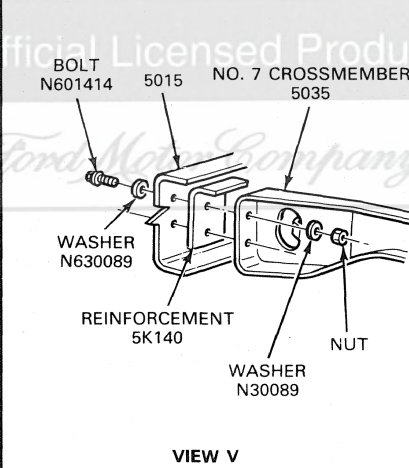
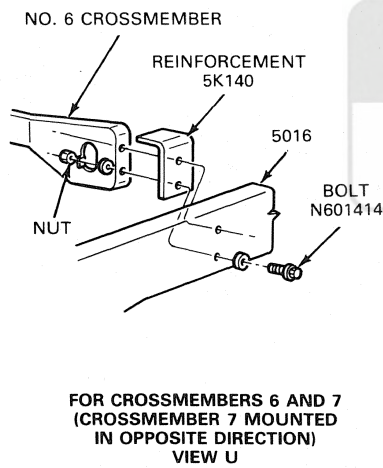
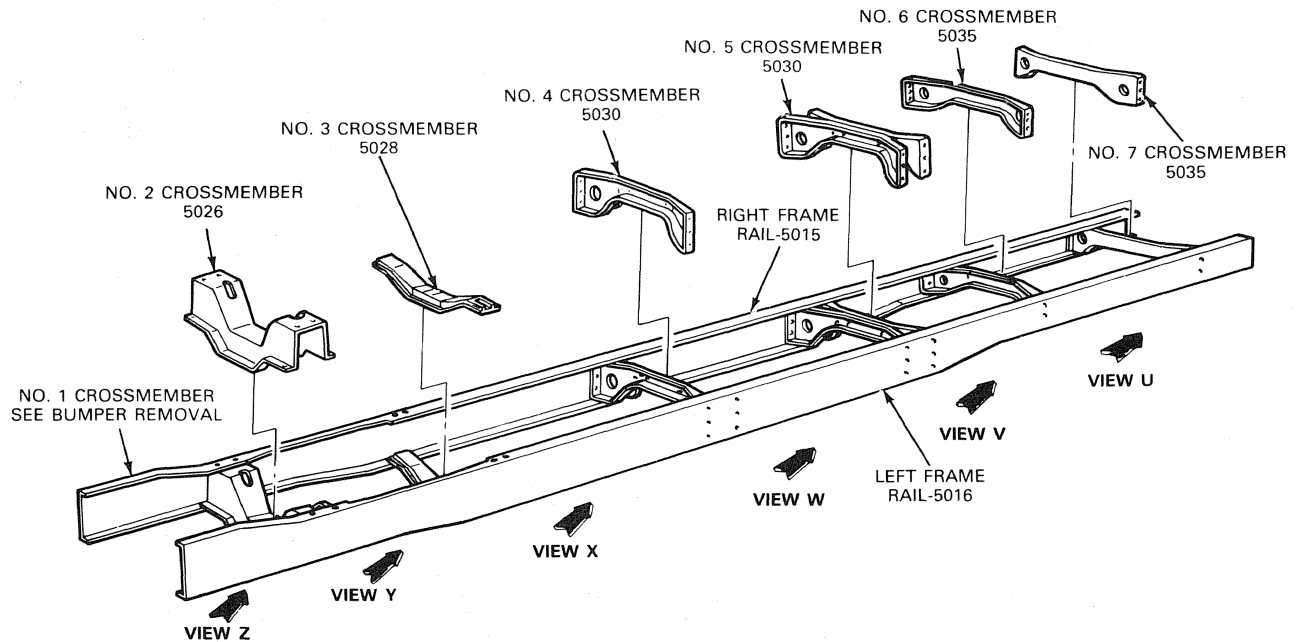


Frame Crossmembers

Removal and Installation

Refer to the following illustration for servicing of frame crossmembers.

REMOVAL AND INSTALLATION (Continued)



F-SUPER DUTY COMMERCIAL STRIPPED CHASSIS – WIRING DIAGRAM

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